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ERRATUM.

In explanation of plate XIX following p. 158 : Fig. 2 *for* "Lateral view of the larva of *C. manilensis*" *read* "Labrum of the same."

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N.B.—An asterisk (*) preceding a line denotes a new variety or subspecies: a dagger (†) indicates a new species; a double dagger (‡) a new genus or subgenus; synonyms are printed in italics.

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I. RHYNCHOTA FROM BARKUDA ISLAND.

By C. A. Paiva, *Assistant, Zoological Survey of India.*

Introductory Note.

I have already described Barkuda I. in these "Records."[1] Here it will be sufficient to repeat that it is a rocky or rather stony island about one mile long by three-quarters of a mile

ERRATUM.

In the sixth line of the second paragraph on page 23 for
"new genus of the family as recorded,"
READ
"no genus of the family is recorded."

indeed, all those species of either Homoptera or Heteroptera that live by sucking leaves or stems of plants are very scarce, the few that occur being found mainly on introduced Leguminosae. The phytophagous species of the island live in most instances by sucking seeds or berries, but the most conspicuous form (*Empysurus johni*) sucks the fruit and young leaves of a fig, and the most abundant (*Petalocnemis obscura*) the stems of the Poison Apple *Datura stramonium*, Linn.,—both plants that are not as a rule attractive to insects. Other groups of insects, with the exception of certain families of beetles, notably the Tenebrionidae and Cicindelidae, are just as poorly represented on the island as the Rhynchota. A factor that may have been of importance in the scarcity of species is the strong breeze that blows across the island almost daily. Insectivorous birds and lizards are, however, few.

There is a small pond in the middle of the island. It is dug in laterite rock and the water has a depth of about five or six feet in the middle, but naturally varies with the rainfall. The pool is roughly circular and about 12 yards in diameter. The bottom is covered with black mud. There are no true water-plants, but a fairly dense growth of sedges springs up round the margin in wet weather. The water is very slightly brackish, opaque and muddy. In this pond certain aquatic Rhynchota abound. The commonest are *Anisops sardea* and *Plea palescens*; other species are much less so. The Hydrometridae are as a rule scarce, but *Gerris tristan*, though not always present, sometimes appears in considerable numbers. Apart from Rhynchota and water-beetles, of which a certain number of species are abundant, the fauna of the pond is by no means rich. The only vertebrate is the frog *Rana*

[1] *Rec. Ind. Mus.* XIII, p. 171 (1917).

I. RHYNCHOTA FROM BARKUDA ISLAND.

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Introductory Note.

I have already described Barkuda I. in these "Records."[1] Here it will be sufficient to repeat that it is a rocky or rather stony island about one mile long by three-quarters of a mile broad, and lies, about a mile offshore, in the Chilka Lake some five miles from the southern end. It is thus situated in the extreme north-eastern corner of the Madras Presidency, in the Ganjam District.

The peculiar features that have influenced its Rhynchotal fauna may be considered a little more fully. The most important of these is the sclerophytic nature of the vegetation. The island is rather densely wooded, but all the trees and bushes have hard glossy foliage, and ordinary succulent vegetation is practically confined to a few creepers and one or two weeds that have established themselves at spots where the jungle has been felled. With these facts is correlated a great scarcity of the smaller Homoptera such as abound in grass and among soft herbage. Indeed, all those species of either Homoptera or Heteroptera that live by sucking leaves or stems of plants are very scarce, the few that occur being found mainly on introduced Leguminosae. The phytophagous species of the island live in most instances by sucking seeds or berries, but the most conspicuous form (*Empysurus johni*) sucks the fruit and young leaves of a fig, and the most abundant (*Petalocnemis obscura*) the stems of the Poison Apple *Datura stramonium*, Linn.,—both plants that are not as a rule attractive to insects. Other groups of insects, with the exception of certain families of beetles, notably the Tenebrionidae and Cicindelidae, are just as poorly represented on the island as the Rhynchota. A factor that may have been of importance in the scarcity of species is the strong breeze that blows across the island almost daily. Insectivorous birds and lizards are, however, few.

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[1] *Rec. Ind. Mus.* XIII, p. 171 (1917).

cyanophlyctis, which breeds there, the only molluscs are *Planorbis exustus*, which is abundant, and *Limnaea ovalis*, which is scarce. A few Chironomid and Culicid larvae occur, and a water-mite, parasitic in its younger stages on *Ranatra*, is common. In the latter part of the " rains " the rocks near the edge become covered with a sponge (*Spongilla alba*)[1] and a Polyzoon (*Plumatella longigemmis*).[2]

The collections on which these notes are based were made on seven different visits to the island, some of which lasted for a week or more, between 1914 and 1917. They were obtained by different members of the Zoological Section of the Indian Museum, now the Zoological Survey of India. The most lengthy of our visits, which took place at all seasons, were made in July and the first week of August, that is to say, in the earlier part of the " rains," which is thus the season best represented in the collection ; but there is comparatively little seasonal variation in the insect life of the island, the climate of which, for purely local reasons, is more uniform than that of most places in Peninsular India.

I have added certain ecological notes to Mr. Paiva's manuscript. They are enclosed in parentheses.

N. ANNANDALE,
Director, Zoological Survey of India.

LIST OF SPECIES.

Fam. Pentatomidae.
- *Coptosoma indicum*, Dist.
- *Macroscytus subaeneus* (Dall.)
- *Cydnus varians*, Fabr.
- *Empysurus johni* (Oshan.)

Fam. Coreidae.
- *Petalocnemis obscura* (Dall.)
- *Homoeocerus albiguttulus*, Stål.
- *Pendulinus antennatus* (Kirby).
- *Eusthetus insularis*, sp. nov.

Fam. Lygaeidae.
- *Aspilocoryphus guttiger* (Dall.).
- *Dieuches femoralis*, Dohrn.
- *Nysius ceylanicus* (Motsch)

Fam. Pyrrhocoridae.
- *Scantius forsteri* (Fabr.)

Fam. Hydrometridae.
- *Mesovelia mulsanti*, Buch. White.
- *Microvelia diluta*, Dist.
- *Gerris tristan*, Kirk.

Fam. Reduviidae.
- *Bagauda splendens*, Dist.
- *Petalochirus burmanus*, Dist.
- *Acanthaspis fulvipes* (Dall.)
- *Ectomocoris cordiger*, Stål.
- *Harpactor marginatus* (Fabr.)
- *Harpactor squalus*, Dist.
- *Harpactor fuscipes* (Fabr.)
- *Harpactor varians*, sp. nov.
- *Sycanus collaris* (Fabr.)

Fam. Nepidae.
- *Laccotrephes griseus* (Guer.)
- *Ranatra ? filiformis*, Fabr.

Fam. Belostomatidae.
- *Sphaerodema molestum* (Duf.)

Fam. Notonectidae.
- *Anisops sardea*, Herr.-Schäff.
- *Anisops niveus* (Fabr.)
- *Plea pallescens*, Dist.

Fam. Corixidae.
- *Micronecta dione*, Dist.

Fam. Cicadidae.
- *Terpnosia jenkinsi*, Distant, var

Fam. Fulgoridae.
- *Dichoptera hyalinata* (Fabr.)

Fam. Membracidae.
- *Leptocentrus substitutus* (Walk.)
- *Coccosterphus minutus* (Fabr.)

Fam. Jassidae.
- *Thomsoniella porrecta* (Walk.)
- *Eutettix phycitis*, Dist.

[1] See Annandale, *Mem. Ind. Mus.* V, p. 25 (1915).
[2] See Annandale, *Rec. Ind. Mus.* XI, pp. 166, 168 (1915).

Family PENTATOMIDAE.

[The members of this family, except *Empysurus johni* (Oshan.), are all very scarce on the island. I have occasionally seen *Macroscytus subaeneus* (Dall.) on the wing a few inches above the ground. In flight it closely resembles beetles of the family Histeridae.]

Coptosoma indicum, Distant.

1902. *Coptosoma indicum*, Distant, *Faun. Brit. Ind. Rhyn.* I, p. 33.

Barkuda, 21-vii-14.

Originally described from Point de Galle, Ceylon. Represented in the collection of the Zoological Survey of India from Calcutta; Medha, Yenna Valley, Satara district, *ca.* 2,200 ft., Bombay Presidency; and Vizagapatam, Madras Presidency.

Macroscytus subaeneus (Dall.)

1851. *Aethus subaëneus*, Dallas, *List Hem.* I, p. 116.
1866. *Macroscytus javanus*, Mayr, *Verh. zool. bot. Ges. Wien.*, p. 361.
1867. *Aethus aequalis*, Walker, *Cat. Het.* I, p. 159.
1868. *Aethus indicus*, Vollenhoven, *Faun. Ind. Néerl.* I, p. 17.
1874. *Macroscytus japonensis*, Scott, *Ann. Mag. Nat. Hist.* (4) XIV, p. 294.
1893. *Macroscytus javanus*, Lethierry and Severin, *Cat. Gen. Hem.* I, p. 71.
1893. *Cydnus subaëneus*, Lethierry and Severin, *tom. cit.*, p. 68.
1899. *Macroscytus subaëneus*, Distant, *Ann. Mag. Nat. Hist.* (7) IV, p. 222.
1902. *Macroscytus subaëneus*, Distant, *Faun. Brit. Ind. Rhyn.* I, p. 96.

Barkuda, at light, 20—21-vii-14, 25-vii—4-viii-17.

Recorded by Distant from Bombay; Deccan; Burma; Karennee, Katha, Schwego-Myo, Palon; Tenasserim; Thagata, Kawkareet. Widely distributed throughout the Malay Archipelago and found in Japan (*Distant.*) Represented in the collection of the Zoological Survey of India from Gopkuda Island, Chilka Lake.

Cydnus varians, Fabr.

1803. *Cydnus varians*, Fabricius, *Syst. Rhyng.* p. 187.
1860. *Aethus cyrtomenoides*, Dohrn, *Stett. ent. Zeit.* XXI, p. 400.
1868. *Aethus varians*, Stål, *Hem. Fabr.* I, p. 6.
1882. *Cydnus varians*, Signoret, *Ann. Soc. Ent. France* (6) II, p. 155, t. vi, f. 92.
1902. *Cydnus varians*, Distant, *Faun. Brit. Ind. Rhyn.* I, p. 92.

Barkuda, vii-14 and 25-vii—4-viii-1917.

Recorded from Bengal; Bombay; Ceylon; Burma; Mandalay; Tenasserim. Represented in the collection of the Zoological Survey of India from Habarane, Ceylon.

Empysurus johni (Oshan.)

1907. *Mussafira johni*, Oshanin, *Ann. Mus. Zool. Acad. Imp. Sci. St. Pétersb.* XII, p. 416.
1908. *Empysurus johni*, Distant, *Faun. Brit. Ind. Rhyn.* IV (Appendix), p. 460, text-fig. 272.

Barkuda, 17-vii-14, 15—22-vii-16, 25-vii—4-viii-17.

[This species is by no means uncommon on the island. It is gregarious in habits and feeds on the fruit and young leaves of the fig *Ficus Rumphii*, Bl., on which small companies of young and adults together may often

be discovered. The flight, though by no means strong, is less weak than might be expected from the shape of the body. Even females fly readily from tree to tree. The natural colour, though not the shape, closely approaches that of the young leaves on which the insect feeds. The colour in life is pale leaf-green ; antennae (except the base of the first joint), eyes and ocelli brick-red; tarsi tinged with brown, a brownish blotch on the dorsal surface of the 2nd joint of the 2nd and 3rd tarsi ; claws white at the base, black at the tip ; membraneous part of the hemelytron colourless, transparent ; edge of abdomen dark brown, a reddish-brown line along lower surface of rostrum.]

In addition to the above characters it may be mentioned that there is a distinct tubercle within each posterior angle of the pronotum ; of the two black lines which are mentioned in the original description as bordering the inner and outer margins of the lateral gutta of the connexivum, the one on the inner border is very faint and sometimes entirely absent. The anal appendage of the male is almost pentagonal in shape, the anterior, lateral and posterior angles being rounded ; it is inserted at the apex of the deeply cleft apical margin of the sixth abdominal segment ; it is deeply excavate dorsally and slightly convex ventrally. The male is much smaller and narrower than the female, the sexes being respectively 22 and 26 millim. in length and 14·5 and 18 millim. in greatest breadth.

In the earlier stages the dorsal surface of the thorax and abdomen is marked with some irregular patches of bright red. A distinct narrow black border runs along the external margins of the head, thorax and abdominal segments. This species was originally described from Kandy, Ceylon, and was not previously represented in the collection of the Zoological Survey of India. It does not appear to be represented in the British Museum collection.

Family COREIDAE.

[In this family again only one species is common, namely *Petalocnemis obscura* (Dall.)]

Petalocnemis obscura (Dall.)

1852. *Acanthocoris obscura*, Dallas, *List Hem.* II, p. 518.
1902. *Petalocnemis obscura*, Distant, *Faun. Brit. Ind. Rhyn.* I, p. 386.

Barkuda, 17-vii-14, 25-vii—4-viii-17.

[This species is by far the commonest bug on the island. It resembles the Malayan *Acanthocoris scaber* (Linn.) in habits, feeding on the poison apple *Datura stramonium*, Linn. The eggs are laid on the lower surface of the leaves in batches of from 17 to 42. Several females usually lay together or in succession, and the young insects of different clutches mingle in a common crowd. Shortly after hatching they migrate as a rule to the stems of the plant, on which they crowd together. Both adults and young in different stages may be discovered in a single crowd. Owing to their mottled colouration they are by no means conspicuous in the broken shadows thrown by the leaves of the plant.]

In the description of the species the dilatation of the apex of the 3rd joint of the antennae has been omitted. This is visible only when

the insect is viewed from the side, as the dilatation is vertical. In the earlier stages the insect is of a very pale colour, with only a few brown markings on its dorsal surface; the dilatation of the 3rd joint of the antennae does not become apparent till about the last but one moult.

It has been recorded from North Bengal; Khasi Hills; Bombay; Poona; and Ceylon. It was not previously represented in the collection of the Zoological Survey of India.

Homoeocerus albiguttulus, Stål.

1873. *Homoeocerus albiguttulus*, Stål, *En. Hem.* III, p. 61.
1902. *Homoeocerus albiguttulus*, Distant, *Faun. Brit. Ind. Rhyn.* I, p. 361.

Barkuda, 25-vii—4-viii-17.

I have compared the only specimen from Barkuda with some specimens of this species in the collection which have been identified by Distant and I find they agree almost exactly in structure. The only very marked difference is the size of the pale luteous spot at the inner angle of the corium, which in the typical form is transverse and broadly margined posteriorly with piceous, while in the Barkuda specimen it is much smaller, being confined to the subquadrate cell of the corium, and without any piceous margin posteriorly. Antennae pale ochraceous with the basal joint greenish ochraceous and the apical half of the distal joint faintly brownish ochraceous. Apical area of the head also tinged with green. Pronotum thickly covered with minute brown punctures, those near the margins being smaller and paler; the anterior and lateral margins greenish, the posterior margin pale ochraceous, impunctate, and the posterior pronotal area obscurely transversely striate. Scutellum ochraceous, rugosely, transversely striate, sparingly punctured, its apex pale and impunctate. Hemelytra ochraceous with the punctures on the clavus arranged almost in regular lines. Underside greenish ochraceous. Length 19 mm., breadth 5 mm. The green colouration in specimens of this genus invariably fades, becoming pale yellow or ochraceous.

Recorded from Sikkim; Khasi Hills; Sibsagar; Burma; Ruby Mines, Karen-ni, and Palon. The type was described from Cochin China; Mr. Distant possesses specimens from the Malay Peninsula and Sumatra.

The specimens in the collection of the Zoological Survey of India are from Sikkim; Arakan; Sibsagar; and Soondrijal, Nepal Valley.

Pendulinus antennatus (Kirby).

1891. *Homoeocerus antennatus*, Kirby, *Journ. Linn. Soc. Zool.* XXIV, p. 90, pl. iv, f. 6.
1902. *Pendulinus antennatus*, Distant, *Faun. Brit. Ind. Rhyn.* I, p. 389.

Barkuda, 25-vii—4-viii-17.

A specimen of this species in the collection of the Zoological Survey of India from Kandy, Ceylon, is identical with the Barkuda specimen, but as members of this genus also have a tendency to lose their natural colour, if preserved dry for any length of time, a few remarks may be made on the colouration of a comparatively fresh specimen. The first, second and third joints of the antennae are olivaceous green, thickly covered with numerous minute black dots, the "ring" at the base of the

third joint is very pale green without any black dots, the fourth joint is reddish-brown with a broad pale basal band. The anterior area of the pronotum, besides having four black dots, has also a distinct black, transverse, irregular fascia. The membrane is shining hyaline, but appears to be fuscous, when at rest, on the dark dorsal surface of the abdomen.

Recorded only from Ceylon.

Eusthetus insularis, sp. nov.

Described from a single specimen taken at Barkuda on 20-vii-1914.

Head black with the lateral lobes, apex of central lobe, an irregular transverse band between eyes, a rather broad band bordering the inner margins of the eyes and extending posteriorly to the basal margin of the head, a linear longitudinal streak between the ocelli and a somewhat broad, medially interrupted fascia on each side of the head, below the antennae and the eyes, brownish ochraceous. Antennae light brown with the apices of the first, second and third joints narrowly piceous; first and third joints subequal in length, second shortest, about half the length of the fourth, which is longest; some short stiff black bristles on the first, second and third joints. Underside of head with a broad central, longitudinal, shining black fascia. Rostrum with the basal joint incrassate, black, the remaining joints brown, with the apical half of the last joint piceous. Rostrum reaching the middle of the mesonotum.

Pronotum brown with three discal, longitudinal, piceous bands, of which the central is broadest, and most distinct. Anterior area with a shallow transverse depression a little behind anterior margin, covered with short silky hairs and with a short, longitudinal, ochraceous line; posterior area slightly raised, with numerous, small, black punctures on disk. Anterior angles rounded, posterior angles acute; posterior margin concavely sinuate before scutellum, obliquely ascending at the sides. Scutellum black, with a central longitudinal line and the apex broadly luteous; disk with some rather long, decumbent hairs. Hemelytra very dark brown, thickly punctured with black; a few linear spots on disk of corium a little beyond middle, luteous; costal margin paler; membrane fuscous, thickly speckled with greyish-white.

Underside shining black, clothed with very fine silvery hairs, which are most dense on the sides of the sternum; a large patch on each lateral area of the prosternum, the apices of the coxal cavities, a spot on the anterior margin of the mesosternum, the lateral and basal margins of the metasternum, a broad oblique lateral fascia on each side of the third abdominal segment and a small spot at the external basal angle of the fourth segment, luteous. Abdomen above black, with a broad longitudinal reddish ochraceous band extending from the basal segment to the apex of the fifth segment, the apical margin of the fifth segment narrowly and the centre of the remaining segments luteous; connexivum black and luteous alternately, the luteous markings less distinct on the underside of the fifth and posterior segments.

Legs ochraceous above, thickly mottled with black, underside of femora blackish; apices of tibiae and tarsi black; intermediate and

posterior femora black with a subapical pale annulation; apices of intermediate femora luteous. Length 10·5 millim.

Type No. 7242/H.I. in the collection of the Zoological Survey of India.

Family LYGAEIDAE.

Aspilocoryphus guttiger (Dall.)

1852. *Lygaeus guttiger*, Dallas, *List Hem.* II, p. 574.
1904. *Aspilocoryphus guttiger*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 11.

Barkuda, 13—18-iv-14, 25-vii—4-viii-17.

[Single individuals of this species are not infrequently seen on the ground in the more open parts of the jungle.]

Recorded from North Bengal. Represented in the collection of the Zoological Survey of India from Calcutta; Ranchi; Dharampur (under stone), *ca.* 5,000 ft., Simla hills; and Kufri, near Simla, W. Himalayas, 8,000 ft.

Nysius ceylanicus (Motsch.)

1863. *Heterogaster ceylanicus*, Motsch., *Bull. Soc. Nat. Mosc.*, p. 78.
1904. *Nysius ceylanicus*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 18.

Barkuda, 25-vii—4-viii-17.

Recorded from East Himalayas: Mungphu; Chota Nagpur, Ranchi; Ceylon. A very widely distributed species.

Dieuches femoralis, Dohrn.

1860. *Dieuches femoralis*, Dohrn, *Stett. ent. Zeit.* XXI, p. 405.
1872. *Rhyparochromus anticus*, Walker, *Cat. Het.* V, p. 100.
1872. *Rhyparochromus siamicus*, Walker, *Cat. Het.* V, p. 102.
1889. *Dieuches alternatus*, Horvath, *Termész. Füzetek*, p. 36.
1904. *Dieuches femoralis*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 84.

Barkuda, 25-vii—4-viii-17.

Recorded from Assam: Margherita, Naga Hills; Sikkim; Kashmir; Ceylon; Burma: Palon, Bhamo; Tenasserim, Malewoon; Batchian. Represented in the collection of the Zoological Survey of India from Siliguri, base of E. Himalayas, Bengal; Kurseong, *ca.* 5,000 ft., Darjiling district, and Pashok, 3,500 ft., Darjiling district, E. Himalayas.

Family PYRRHOCORIDAE.

Scantius forsteri (Fabr.)

1781. *Cimex forsteri*, Fabricius, *Spec. Ins.* II, p. 368.
1781. *Cimex clavimanus*, Fabricius, *Spec. Ins.* II, p. 368.
1822. *Lygaeus deustus*, Thunberg, *Hem. Rostr. Cap.* IV, p. 3.
1848. *Pyrrhocoris clavimanus*, Herrich-Schäffer, *Wanz. Ins.* VIII, p. 102, f. 871.
1848. *Pyrrhocoris forsteri*, Herrich-Schäffer, *Wanz. Ins.* VIII, p. 102, f. 872.
1860. *Dermatinus centralis*, Signoret, *Ann. Soc. Ent. Fr.* p. 952.
1865. *Scantius forsteri*, Stål, *Hem. Afr.* III, p. 10.
? 1873. *Scantius volucris*, Gerstaecker, in V. d. Decken's *Reise*, III, p. 413.
1904. *Scantius volucris*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 117.
1910. *Scantius forsteri*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p 98.

Barkuda, 15—22-vii-16, 25-vii—4-viii-17.

[This species is entirely terrestrial in habits, hiding under stones and recumbent tree trunks.]

Recorded from ? Madras; ? Coonoor; Purneah, Bihar; S. Africa; Madagascar; Seychelle Islands. Represented in the collection of the Zoological Survey of India from Meerut, United Provinces of Agra and Oudh; Purneah district, Bihar; and on board ship off Coconada, Madras Coast.

Family HYDROMETRIDAE.

[*Gerris tristan*, Kirk., is the only species of this family that I have seen in large numbers on the pond in the middle of the island. It is not, however, a constant inhabitant, though it was common in July, 1916. I could not find a single specimen in July, 1917.]

Mesovelia mulsanti, Buch. White.

1879. *Mesovelia mulsanti*, Buchanan White, *Tr. Ent. Soc. Lond.*, p. 268.
1884. *Mesovelia bisignata*, Uhler, in Kingsley's *Stand. Nat. Hist.* II, p. 273, f. 324.
1893. *Mesovelia bisignata*, Uhler, *Proc. Zool. Soc. Lond.*, 1893, p. 706.
1898. *Mesovelia mulsanti*, Champion, *Biol. Centr. Amer. Rhyn.* II, p. 123, pl. viii, ff. 10 and 11.
1900. *Mesovelia orientalis*, Kirkaldy, *Ann. Mus. Civ. Gen.* XL, p. 808.
1904. *Mesovelia mulsanti*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 169.
1910. *Mesovelia mulsanti*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 137.
1915. *Mesovelia mulsanti*, Annandale and Kemp, *Mem. Ind. Mus.* V, p. 181.

Barkuda, on pond in the middle of the island, 15—22-vii-16, 25-vii—4-viii-17.

Recorded from Bengal: Calcutta (at light), Port Canning (brackish pools), Rajshahi; Puri, Orissa Coast; Lucknow, United Provinces; Peradeniya, Tangalla, Ceylon; Sumatra; also found in North and Central America, and in the Antilles. Represented in the collection of the Zoological Survey of India from Bengal: Calcutta and Port Canning. Orissa: Puri and Barkul. United Provinces: Lucknow. Kumaon: Naini Tal, *ca.* 6,400 ft. Madras: Ganta Sila hill near Rambha, Chilka Lake. South India: Bangalore. Tenasserim: Kawkareik, Amherst district. Andamans: Port Blair.

Microvelia diluta, Dist.

1909. *Microvelia diluta*, Distant, *Ann. Mag. Nat. Hist.* (8) III, p. 500.
1910. *Microvelia diluta*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 139.

Barkuda, on pond in the middle of the island, 25-vii—4-viii-17.

Recorded from Calcutta and Rajshahi, Bengal, and represented in the collection of the Zoological Survey of India from Calcutta and Rajshahi, Bengal; Lucknow, United Provinces; Puri, Orissa Coast; Rambha, Ganjam district, Madras Presidency.

Gerris tristan, Kirk.

1899. *Gerris tristan*, Kirkaldy, *Rev. Ent.* p. 88.
1904. *Gerris tristan*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 179.
1910. *Gerris tristan*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 144.
1915. *Geris tristan*, Annandale and Kemp, *Mem. Ind. Mus.* V, p. 182.

Barkuda, on pond in the middle of the island, 25-vii—4-viii-17.

Recorded from Bengal: Port Canning, Dhappa, near Calcutta, Rajshahi. Orissa: Sur Lake, Puri district. United Provinces: Naini Tal, Kumaon. Burma: Moulmein. Ceylon. Represented in the collection of the Zoological Survey of India from Bengal: Calcutta, Dhappa, Port Canning, Rajshahi, Berhampore Court. United Provinces: Naini Tal, 6,400 ft., Malwa Tal, 3,600 ft., Sat Tal, 4,500 ft., Bhim Tal, 4,450 ft., and Kathgodam, 1,200 ft., all in Kumaon. Orissa: Bhubaneswar, Barkul, Sur Lake, Puri district. Madras: on surface of Chilka Lake, among rocks at edge of Chilka Lake, base of Ganta Sila hill near Rambha.

Family REDUVIIDAE.

[All the members of this family found on the island are apparently of terrestrial habits and probably predaceous. None of them, however, are at all common, and in most cases only single specimens were captured.]

Bagauda splendens, Dist.

1906. *Bagauda splendens*, Distant, *Ann. Mag. Nat. Hist.* (7) XVIII, p. 364.
1909. *Bagauda decorus*, Breddin, *Ann. Soc. Ent. Belg.* 1909, p. 301.
1910. *Bagauda splendens*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 176.

Barkuda, 15—22-vii-16, 25-vii—4-viii-17.

Recorded only from Ceylon and not previously represented in the collection of the Zoological Survey of India.

[This species lives amongst vegetation at the edge of water.]

Petalochirus burmanus, Dist.

1903. *Petalochirus burmanus*, Distant, *Ann. Soc. Ent. Belg.* 1903, p. 55.
1904. *Petalochirus burmanus*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 242.

Barkuda, 15-22-vii-16.

Recorded from Burma, Bhamo, and not previously represented in the collection of the Zoological Survey of India.

Acanthaspis fulvipes (Dall.)

1850. *Platymeris fulvipes*, Dallas, *Trans. Ent. Soc. Lond.* 1850, p. 6, pl. ii, fig. 3.
1863. *Acanthaspis fulvipes*, Stål, *Ann. Soc. Ent. France*, 1863, p. 149.
1873. *Acanthaspis quadrinotata*, Walker, *Cat. Het.* VII, p. 175.
? *Acanthaspis quadristillatus*, Stål, MS.
1902. *Acanthaspis fulvipes*, Distant, *Ann. Mag. Nat. Hist.* (7) X, p. 183.
1904. *Acanthaspis fulvipes*, Distant, *Faun. Brit. Ind. Ryhn.* II, p. 259.

Barkuda, at light, 19-vii-14 and 15-22-vii-16.

Recorded from Bhutan; Sikkim; Sibsagar, Assam; East Bengal; and represented in the collection of the Zoological Survey of India from Bengal: Rangamati, Chittagong Hill Tracts; Darjiling district: Sukna, 500 ft., Sevoke, in stable at Kalijhora, Teesta Valley. Chota Nagpur: Ranchi. Assam: Cachar and Sibsagar.

On the 19th of September, 1916 the Rev. Dr. Sutherland of Kalimpong gave us a larva of a Reduviid bug covered all over with dust and dirt, which he had caught crawling about the floor of a stable at Kalijhora, on the Teesta-Kalimpong Road. It was kept alive in a breeding cage, being fed occasionally with small flies, chiefly Muscids. On the 1st of November it cast its skin. This probably took place during

the night, as when it was observed on the morning of the 2nd November it was seen to have covered its new skin with a very thick coating of dust and dirt, much thicker even than in its earlier stage. As the days went on, several dead flies, together with other rubbish, were found collected on the back of the bug, presumably placed there by it after it had sucked them dry. It was also noticed that it seldom attacked the flies by day unless it had had no food for several days. These bugs have a habit of seeking dark corners in houses and crevices in trees and probably never feed in bright sunshine. Our larva was, however, always on the alert during the day and when disturbed it would make a sudden dart from one place to another, remaining perfectly still for some time, thus giving itself the appearance of a piece of rubbish being blown about by the wind. It continued to add fresh rubbish to its cloak and thus seemed to grow bigger daily until it emerged as an adult on the 10th of March, 1917. It is probable that a whole year is occupied in its complete life-cycle.

The two cast skins and the adult are preserved in the collection of the Zoological Survey of India.

Ectomocoris cordiger, Stål.

1866. *Ectomocoris cordiger*, Stål, *Öfv. Vet.-Ak. Förh.* 1866, p. 256.
1873. *Pirates adjunctus*, Walker, *Cat. Het.* VII, p. 114.
1902. *Ectomocoris cordiger*, Distant, *Ann. Mag. Nat. Hist.* (7) X, p. 283.
1904. *Ectomocoris cordiger*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 295.

Barkuda, 15—25-vii-16.

Recorded from North Bengal ; Sylhet ; Bombay ; Bor Ghát ; Ceylon ; Persian Gulf. Represented in the collection of the Zoological Survey of India from Bengal : Calcutta (at light), Madhupur (at light), Tinpahar, near Rajmahal. Behar : Purneah. Chota Nagpur : Ranchi and base of hills, Chakradharpur, Singhbhum district. United Provinces : Meerut, Almora, 5,500 ft., Kumaon. S. India : Nilgiris, 3,500 ft. Lower Burma : Kawkareik to third camp, Amherst district.

Harpactor marginatus (Fabr.)

1794. *Reduvius marginatus*, Fabricius, *Ent. Syst.* IV, p. 196.
1874. *Chirillus marginatus*, Stål, *Ent. Hem.* IV, p. 39.
1881. *Harpactor marginatus*, Reuter, *Ac. Soc. Sc. Fenn.* XII, p. 293.
1891. *Sycanus ? militaris*, Kirby, *Journ. Linn. Soc. Zool.* XXIV, p. 119.
1903. *Harpactor marginatus*, Distant, *Ann. Mag. Nat. Hist.* (7) XI, p. 205.
1904. *Harpactor marginatus*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 332.

Barkuda, 21-vii-14.

Recorded from "North India ;" Vizagapatam ; Ceylon. Represented in the collection of the Zoological Survey of India from Bengal : Calcutta ; Tinpahar, near Rajmahal. Chota Nagpur : Chaibassa. United Provinces : Hardwar and Lucknow. Bombay : Dhom, Krishna Valley, *ca.* 2,400 ft. ; Beyt, Dwarka, Kathiawar ; Uparkot, Janagadh, Kathiawar ; Sasan, Kathiawar. Madras : Vizagapatam. South India : Bangalore.

Harpactor squalus, Dist.

1904. *Harpactor squalus*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 333.

Barkuda, xi-14 and 15—22-vii-16.

Recorded only from Sikkim ; Punkabari. Represented in the collection of the Zoological Survey of India from Bengal : Manbhum. Chota Nagpur : Chakradharpur ; pass between Chaibassa and Chakradharpur. Orissa : Balugaon and Dhauli, Puri district ; Hill above Barkul, Puri district, 0—1,000 ft. Madras : under stone on hill near Rambha, and at Rambha, Ganjam district.

Harpactor fuscipes (Fabr.)

1787. *Reduvius fuscipes*, Fabricius, *Mant. Ins.* II, p. 312.
1803. *Reduvius fuscipes*, Fabricius, *Syst. Rhyng.*, p. 278.
1804. *Reduvius sanguinolentus*, Wolff, *Ic. Cim.* IV, p. 166, f. 160.
1825. *Reduvius corallinus*, Le Pelétier et Serville, *Enc. Méth.* X, p. 279.
1868. *Reduvius fuscipes*, Stål, *Hem. Fabr.* I, p. 110.
1891. *Harpactor bicoloratus*, Kirby, *Journ. Linn. Soc. Zool.* XXIV, p. 120.
1903. *Harpactor fuscipes*, Distant, *Ann. Mag. Nat. Hist.*, (7) XI, p. 205.
1904. *Harpactor fuscipes*, Distant, *Faun. Brit. Ind. Rhyn.* II, p. 333.

Barkuda, 17—21-vii-14, 15—22-vii-16.

Recorded from Bombay, Bor Ghât ; Ceylon. Represented in the collection of the Zoological Survey of India from Bengal : Calcutta ; Siliguri ; Punkhabari, Darjiling district, and Bombay.

Harpactor varians, sp. nov.

Barkuda, 21-vii-14.

Head, pronotum, scutellum and legs shining black, with some short stiff hairs on the legs and the margins of the pronotum. A spot at the inner margin of each eye, posteriorly, a lateral spot before each eye, a linear spot between the ocelli on disk, and a central longitudinal fascia on the underside of the head, luteous ; (these markings are liable to variation) ; head deeply impressed behind eyes. Antennae light brown, the base of the first joint shining black, its apex and the whole of the second joint dark brown ; first joint longest, equal in length to the second and third together, second shortest, third and fourth subequal. Anteocular area of head a little shorter than the postocular.

Rostrum reaching the anterior coxae ; the first joint longer than anteocular area of head, equal to the second joint, third joint shortest. Pronotum with the anterior lobe convex, centrally longitudinally sulcate, the anterior angles produced into two short obtuse spines directed slightly backwards ; posterior lobe with the disk slightly rounded ; the sides depressed, lateral angles rounded and obliquely suberect, posterior margin straight before the scutellum, obliquely ascendant at the sides. Sometimes there are three very pale luteous spots on the disk of the posterior lobe, two on the anterior area and one on the posterior margin. Scutellum with its apex cretaceous-white. Hemelytra very pale luteous, transparent, the inner margin of the clavus slightly fuscous, apical angle of corium longly produced ; membrane shining, hyaline. Abdomen above and beneath luteous, the central portion of the disk above dark brown ; connexivum with linear brown marks on the third to the fifth segments. Legs with the femora nodulosely incrassate.

Length 7-8 millim.

Type No. 3924/H.I. in the collection of the Zoological Survey of India.

Sycanus collaris (Fabr.)

1781. *Reduvius collaris*, Fabricius, *Spec. Ins.* II, p. 380.
1874. *Sycanus collaris*, Stål. *Ent. Hem.* IV, p. 28.
1904. *Sycanus collaris*, Distant (part.), *Faun. Brit. Ind. Rhyn.* II, p. 351.
1910. *Sycanus collaris*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 208.

Barkuda, 15—22-vii-16.

Recorded from Bengal; Ceylon; Malacca. Represented in the collection of the Zoological Survey of India from Bengal: Sahebganj; Darjiling, *ca.* 7,000 ft., Punkabari, Darjiling district, E. Himalayas. Chota Nagpur: Ranchi. Orissa: Angul. Madras. South India: Teppukadu, Nilgiri hills, 3,000 ft.

Family NEPIDAE.

Laccotrephes griseus (Guér.)

1829—1838. *Nepa griseus*, Guérin, *Iconogr. Règne Anim., Ins.*, p. 352, pl. lvii, f. 7.
1868. *Laccotrephes maculatus*, Stål (part.), *Hem. Fabr.* I, p. 135.
1906. *Laccotrephes maculatus*, Distant (part.), *Faun. Brit. Ind. Rhyn.* III, p. 19.
1910. *Laccotrephes griseus*, Montandon, *Ann. Mus. Zool. Napoli*, III, n. 10, p. 3.
1910. *Laccotrephes griseus*, Distant, *Faun. Brit. Ind. Ryhn.* V (Appendix), p. 314.

Barkuda, 15—22-vii-16, 25-vii—4-viii-17.

Recorded from Bengal; Madras; Pondicherry; Ceylon; Burma; Malacca; Seychelles; Mahe. Represented in the collection of the Zoological Survey of India from Punjab: Rawalpindi. W. Himalayas: Dharampur Kooa, Patiala State, base of Simla hills; Lobha, Garhwal district. United Provinces: Bhimtal, 4,450 ft.; Kumaon; Gorakhpur; Lucknow; Mowai, Bara Banki; Chukri Mukri. Nepal Terai. Behar: Siripur, Saran. Bengal: Manbhum; Berhampore Court; Calcutta; Durgapur, near Calcutta (sitting on a reed at edge of brackish water canal. *N. A.*); Rajshahi; Siliguri. Orissa: Puri; Satpura, Puri district. Bombay: Bandra; Dhankal, near Helvak, Satara district, 2,400-2,600 ft.; Kathiawar; Porbandar. Madras: south end of Lake Chilka. Cochin State: Kavalai, 1,300-3,000 ft. Travancore: Tenmalai, W. Ghats (west side). Ceylon: Colombo; Peradeniya. Siam: Pak Raw, Tale Sap (in small creek).

In his Appendix Distant states that the difference between *Laccotrephes maculatus* (Fab.) and *Laccotrephes griseus* (Guér.) is that the anterior area of the prosternum in the former is entirely straight and non-tuberculous, while in the latter this area has a strong acute tubercle. I have examined several specimens in the collection of the Zoological Survey of India including one from Lobha and find that the tubercle is present in all of them and there is no specimen, agreeing in size with *L. griseus*, which is without this acute tubercle. *L. maculatus*, therefore, does not appear to be represented in this collection.

Ranatra ? filiformis, Fabr.

1790. *Ranatra filiformis*, Fabricius, *Skrivt. af Naturh. Selsk.* I, i, p. 228.3.
1794. *Ranatra filiformis*, Fabricius, *Ent. Syst.* IV, p. 64.
1868. *Ranatra filiformis*, Stål, *Hem. Fabr.* I, p. 135.
1906. *Ranatra filiformis*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 21.

A very badly preserved specimen from Barkuda, 15—22-vii-16.

Owing to its bad condition I am not quite sure of the identity of this specimen. Structurally it agrees with the description given by Distant.

Recorded from Quetta; Karachi; Behar; Assam: Sibsagar; Tranquebar; Bombay; Johore; Phillippines.

Family BELOSTOMATIDAE.

Sphaerodema molestum (Duf.)

1863. *Appasus molestum*, Dufour, *Ann. Soc. Ent. Fr.*, 1863, p. 395.
1863. *Nervinops rusticus*, Dufour, *Ann. Soc. Ent. Fr.*, 1863, p. 399.
1871. *Diplonychus molestum*, Mayr, *Verh. zool.-bot. Ges. Wien*, XXI, p. 437.
1871. *Diplonychus subrhombeus*, Mayr, *Verh. zool.-bot. Ges. Wien*, XXI, p. 437.
1906. *Sphaerodema molestum*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 36.

Barkuda, in small pond in the middle of the island, 15-22-vii-16.

Recorded from Kashmir; Calcutta tanks; Malacca.

Family NOTONECTIDAE.

[All the species represented in the collection are abundant in the pond, but *Anisops niveus* is less so than the other two.]

Anisops sardea, Herr.-Schäff.

1775. ? *Notonecta alba*, Forskål, *Descr. Amin. Orient.*, p. xxiii.
1837. *Anisops nivea*, Spinoret, nec Fabricius, *Ess. Hem.*, p. 58.
1851. *Anisops productus*, Fieber, *Rhynchotogr.*, p. 60.
1852. *Anisops sardea*, Herrich-Schäffer, *Wanz. Ins.* IX, p. 40, f. 904.
1855. *Anisops natalensis*, Stål, *Ofv. Vet.-Ak. Förh.* XII, p. 89.
1865. *Anisops productus*, Stål, *Hem. Afr.* III, p. 191.
1870. *Notonecta nanula*, Walker, *Zoologist*, 1870, p. 2381.
1904. *Anisops sardea*, Kirkaldy, *Wien. ent. Zeit.* XXIII, p. 114 et syn.
1906. *Anisops sardea*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 45.

Barkuda, in small pond in the middle of the island, 16-17-vii-14, 15—22-vii-1916, 25-vii—4-viii-17.

Recorded from Bombay; Burma: Minhla. Widely distributed in S. Palaearctic and Ethiopian Regions.

Anisops niveus (Fabr.)

1775. *Notonecta nivea*, Fabricius, *Syst. Ent.*, p. 690.
1798. *Notonecta ciliata*, Fabricius, *Ent. Syst. Suppl.*, p. 524.
1851. *Anisops hyalinus*, Fieber, *Abh. böhm. Ges. Wiss.* (5) VII, p. 482.
1868. *Anisops ciliatus*, Stål, *Vet.-Ak. Handl.* VII, 11, p. 137.
1873. *Anisops pellucens*, Gerstaecker, Van der Decken's *Reise*, III, 2, p. 424.
1895. *Anisops scutellaris*, de Carlini, *Ann. Mus. Civ. Gen.* XXXV, p. 123.
1899. *Anisops niveus*, Kirkaldy, *Ann. Soc. Ent. Fr.* 1899, p. 105.
1904. *Anisops niveus*, Kirkaldy, *Wien. ent. Zeit.* XXIII, p. 118.
1906. *Anisops niveus*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 46.

Barkuda, in small pond in the middle of the island, 16-vii-14, 25-vii—4-viii-17.

Plea pallescens, Dist.

1906. *Plea pallescens*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 48.
1910. *Plea pallescens*, Distant, var. *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 336.

Barkuda, in small pond in the middle of the island, 15-22-vii-1916, 25-vii—4-viii-1917.

Recorded from Bengal: Calcutta (in tanks); Rajshahi. United Provinces: Lucknow. Cochin State: Ernakulam.

Family CORIXIDAE.

Micronecta dione, Dist.

1910. *Micronecta dione*, Distant, *Faun. Brit. Ind. Rhyn.* V (Appendix), p. 348.

Barkuda, 25-vii—4-viii-17.
Recorded from Bengal: Asansol; Calcutta (at light).

Family CICADIDAE.

Terpnosia jenkinsi, Distant, var.

1912. *Terpnosia jenkinsi*, Distant, *Ann. Mag. Nat. Hist.* (8) IX, p. 183.
1916. *Terpnosia jenkinsi*, Distant, *Faun. Brit. Ind. Rhyn.* VI (Appendix), p. 9.

A single male from Ganta Sila hill near Rambha, Ganjam district, Madras Presidency, 22-vii-16.

This specimen agrees structurally with a specimen in the collection of the Zoological Survey of India from Paresnath hill, 4,000-4,400 ft., Bengal (v-1909), identified by Distant, except that it is slightly smaller and narrower. The markings on the body, both above and beneath, although similar in position and shape, are much smaller and narrower, giving the insect a paler appearance. It is probably a pale variety of *T. jenkinsi* and like it there is an abnormality in the tegmen, where there is a distinct small cell at its apical margin between the first and second apical areas, the one on the right tegmen being larger than the one on the left.

[This Cicada is rare on Barkuda, but common on a neighbouring island and on the hill Ganta Sila near Rambha. It is diurnal in habits and always lives amidst a dense growth of trees or shrubs. Its song is very harsh and never prolonged for more than a few minutes at a time. It commonly settles on tree-trunks, on which it is most inconspicuous. The male begins to sing as soon as he is settled, and as a rule flies off to another tree as soon as his song is finished. Although the species was heard daily in July and August, and frequently seen, as it flew from tree to tree, we succeeded in catching only one specimen.]

Family FULGORIDAE.

Dichoptera hyalinata (Fabr.)

1781. *Fulgora hyalinata*, Fabricius, *Spec. Ins.* II, p. 315.
1791. *Fulgora hyalinata*, Olivier, *Enc. Méth.* VI, p. 572.
1800. *Fulgora hyalinata*, Donovan, *Ins. Ind.* t. vii, f. 3.
1818. *Flata hyalinata*, Germar, *Mag. Ent.* III, p. 190.
1834. *Pseudophana hyalinata*, Burmiester, *Handb. Ent.* II (1), p. 160.
1839. *Dichoptera hyalinata*, Spinoret, *Ann. Soc. Ent. Fr.*, 1839, p. 289, t. xiii, f. 3;
1886. *Dichoptera hyalinata*, Atkinson, *Journ. As. Soc. Bengal* LV, p. 23.
1906. *Dichoptera hyalinata*, Distant, *Faun. Brit. Ind. Rhyn.* III, p. 238.

Barkuda, 15—22-vii-16, 25-vii—4-viii-17.

[This species usually rests on the bark of trees, on which it is very inconspicuous. It is not at all rare on Barkuda.]

In one sex, probably the female, the tegmina have, besides the piceous transverse fascia at apices of ulnar veins, another piceous transverse fascia between this fascia and the base.

Recorded from Bengal; Calcutta; Bombay; Bangalore; Ceylon: Tangalla; Andamans.

Family MEMBRACIDAE.

[I doubt whether any species of this family breeds on the island.]

Leptocentrus substitutus (Walk.)

1851. *Centrotus substitutus*, Walker, *List Hom.* II, p. 605.
1858. *Centrotus obliquus*, Walker, *Ins. Saund., Hom.* p. 79.
1858. *Centrotus flexicorne*, Walker, *Ins. Saund., Hom.* p. 78.
1885. *Leptocentrus substitutus*, Atkinson, *Journ. As. Soc. Bengal* LIV, p. 87.
1886. ? *Centrotus flexicorne*, Atkinson, *Journ. As. Soc. Bengal* LV, p. 197.
1886. ? *Centrotus obliquus*, *id. ibid.* LV, p. 197.
1908. *Leptocentrus substitutus*, Distant, *Faun. Brit. Ind. Rhyn.* IV, p. 29.
1916. *Leptocentrus substitutus*, Distant, *Faun. Brit. Ind. Rhyn.* VI (Appendix), p. 154.

Barkuda, 15—22-vii-16, 25-vii—4-viii-17.

Recorded from Bengal: Calcutta, Rajmahal. Behar: Bhogaon, Purneah district. Orissa: Puri. Bombay. Madras: Gopkuda Island, Chilka Lake, Ganjam district. S. India: Mysore. Ceylon: Peradeniya, Elephant Pass, Balangoda, Colombo, Yatiyantota, Kelan Valley.

[This is a very common insect on diverse plants in many parts of India. On Barkuda I have only seen it on the leguminous shrub *Crotolaria striata*, D. C., and have never succeeded in finding the young, which in other parts of India are usually to be found with the adult.]

Coccosterphus minutus (Fabr.)

1798. *Membracis minutus*, Fabricius, *Ent. Syst. Suppl.*, p. 514.
1803. *Centrotus minutus*, Fabricius, *Syst. Ryhng.*, p. 22.
1846. ? *Scaphula minutus*, Fairmaire, *Ann. Soc. Ent. Fr.* 1846, p. 495.
1869. *Coccosterphus minutus*, Stål, *Hem. Fabr.* II, p. 51.
1885. *Coccosterphus minutus*, Atkinson, *Journ. As. Soc. Beng.* LIV, p. 89.
1903. *Coccosterphus minutus*, Melichar, *Hom. Faun. Ceylon*, p. 121.
1908. *Coccosterphus minutus*, Distant, *Faun. Brit. Ind. Rhyn.* IV, p. 71.
1916. *Coccosterphus minutus*, Distant, *Faun. Brit. Ind. Rhyn.* VI (Appendix), p. 175.

Barkuda, 25-vii—4-viii-17, also one specimen identified by Distant from the Chilka Survey, 21-vii-14.

Stål recorded it from "Tranquebar."

Family JASSIDAE.

[The members of this family are very scarce on this island. I have observed *Eutettix phycitis*, Dist., feeding on *Crotolaria striata*, D. C., but with this exception, the few specimens we obtained flew to light in the evening.]

Thomsoniella porrecta (Walk.)

1858. *Acocephalus porrectus*, Walker, *List Hem. Suppl.*, p. 262.
1859. *Platymetopius lineolatus*, Motsch., *Étud. Ent.* VIII, p. 114.
1870. *Hecalus kirschbaumii*, Stål, *Ofv. Vet.-Ak. Förh.*, 1870, p. 737.
1880. *Thomsoniella kirschbaumii*, Signoret, *Ann. Soc. Ent. Fr.* 1880, p. 52, t. i, f. 44.
1885. *Thomsoniella kirschbaumii*, Atkinson, *Journ. As. Soc. Beng.* LIV, p. 104.
1903. *Thomsoniella porrecta*, Melichar (part.) *Hom. Faun. Ceylon*, p. 173.
1906. *Thomsonia lineolatus*, Kirkaldy, *Rep. Exp. Stat. Haw. Plant. Assoc.*, pt. IX, p. 337.
1906. *Thomsonia kirschbaumii*, Kirkaldy, *Rep. Exp. Stat. Haw. Plant. Assoc.* pt. IX, p. 338.
1908. *Thomsoniella porrecta*, Distant, *Faun. Brit. Ind. Rhyn.* IV, p. 278.

Barkuda, 25-vii—4-viii-17.

Recorded from Bengal : Calcutta. Behar : Pusa. Burma : N. Shan Hills. Maldive Islands : Minikoi. Ceylon : Peradeniya, Newara Eliya, Puttalam, Negombo, Bandarawella. Phillippines. Queensland : Cairns.

Eutettix phycitis, Distant.

1908. *Eutettix phycitis*, Distant, *Faun. Brit. Ind. Rhyn.* IV, p. 363.

Barkuda, 25-vii—4-viii-19.

Recorded from Bengal : Calcutta. Behar : Pusa ; Purneah. Ceylon : Kandy.

Also three specimens representing three species of Jassidae. They all belong to very minute species which appear to fall into the subfamily Typhlocybinae.

II. SOME UNDESCRIBED TADPOLES FROM THE HILLS OF SOUTHERN INDIA.

By N. Annandale, *D.Sc., F.A.S.B., Director, Zoological Survey of India.*

(Plate I.)

With one exception the tadpoles here described were found in the hills of Cochin, in most cases with young frogs of their species, by Dr. F. H. Gravely and Mr. B. Sundara Raj in September, 1914. The tadpole of *Nyctibatrachus pygmaeus* was, however, obtained by Capt. R. B. S. Sewell, I.M.S., in a small lake in the Nilgiris. The species from Cochin are particularly interesting as illustrating peculiar adaptations in tadpoles that live in hill-streams.

Rana verrucosa, Günther.

(Plate I, figs. 1, 1*a*.)

Boulenger, *Faun. Brit. Ind., Rept.*, p. 448 (1890).

The tadpole is small, by no means stout ; the head and body are rather narrowly ovoid and somewhat depressed ; the snout is bluntly pointed and declivous ; the nostrils as seen from above appear to be nearer the tip of the snout than to the eyes ; the distance between them is about half that between the eyes, which are situated on the dorsal surface but directed outwards and are evidently prominent in life. The spiracle is situated a little below the eye, nearer to it than to the posterior end of the body ; it is tubular in form and points backwards and a little upwards. The ventral surface is convex.

The mouth-disk is very small and of the normal type, directed downwards and a little forwards, distinctly transverse in form, with a lateral emargination on either side ; the anterior margin of the upper lip is fringed with teeth and devoid of papillae ; the lateral margins are fringed with papillae, which become rather longer at the sides of the posterior margin ; the middle part of this margin is smooth. The dental formula is 1 : 1+1/3. The upper beak is crescentic and slender ; the lower beak broadly V-shaped. The margins of both parts are very minutely serrated ; the basal half of the lower beak is colourless.

The tail is relatively short and slender, tapering gradually, sharply pointed, with the fin-membranes relatively broad and the upper one commencing on the posterior part of the body. The anus is directed to the right.

The dorsal surface of the body is blackish, indistinctly mottled and marbled with white ; on the snout and sides the colourless markings are of greater extent and more conspicuous ; a dark spot occurs over each nostril ; the ventral surface is colourless and transparent ; the tail is whitish with conspicuous dark brown spots and irregular markings.

Measurements of a specimen with the hind legs well-developed :—

	mm.
Total length	27·5
Length of head and body	11
Breadth of head and body	7
Depth of body	5
Greatest depth of tail	4

Specimens of this tadpole were found in an isolated pool in a rock beside a stream in the Cochin forests in September, 1914. Although it occurs in hill-country, the species probably does not breed as a rule in streams, for the larva is normal and not of any of the types commonly associated with life in running water.

In general appearance and structure the tadpole resembles that of *Rana limnocharis*, but it is stouter and has a relatively shorter tail.

Distribution.—Jungles of the southern part of the Malabar zone.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17659-60. Parambikulam, 1700-3200 ft., Cochin State (*F. H. Gravely*).

Rana beddomei (Günther)

(Plate I, figs. 4, 4*a*, 4*b*.)

Boulenger, *op. cit.*, p. 453.

The tadpole is small and very slender ; the branchial region is prominent on either side ; the head and body are narrowly oval ; the snout is pointed and declivous ; the eyes are situated on the dorsal surface and directed upwards ; they are very large and prominent ; the nostril, which is small and inconspicuous, is nearer to the eye than to the tip of the snout. The spiracle, which is not at all tubular but small and slit-like, is situated on the lower part of the left side of the body and is directed outwards and a little backwards ; it is rather nearer to the eye than to the posterior edge of the body. On the dorsal surface a narrow groove extends inwards in a slanting direction from near the middle of each eye to meet its fellow on the opposite side ; the combined groove extends backwards from a line joining the posterior third of the eyes as far as the base of the dorsal fin.

The mouth-disk is broadly triangular, entirely ventral in position ; the upper lip, which is devoid of tubercles, is very distinct from the lower ; it is narrowly but deeply notched in the middle line ; the lower lip has a marginal fringe of minute tubercles. The dental formula is $1+1:1:2+2/2+2:2$; the outermost row of teeth on the upper lip is situated on its margin ; the beak is narrow and prominent, strongly hooked like that of a parrot ; both the upper and the lower beaks are entirely black and have smooth edges.

The tail is extremely long and slender, and has, even in the young tadpole, the fin-membranes very poorly developed ; the muscular part tapers gradually to a fine point ; the dorsal membrane consists of a low ridge very inconspicuous on the anterior half of the tail ; the ventral membrane is slightly better developed but also vestigial. The anus

is dextral, but not very strongly so; it does not form a prominent tubercle or tube.

The dorsal surface of the head and body is of a dark purplish-brown, minutely speckled with white and somewhat marbled on the snout. The lateral surface of the tail is also purplish-brown marbled with white; the whole of the ventral surface is colourless.

The hind limbs appear at an early stage of development and attain a large size and well-developed condition long before the appearance of the fore limbs.

The following are measurements of (A) of a specimen in which the hind limbs appear as small but elongated buds, and (B) of one in which they are fully developed.

	A.	B.
	mm.	mm.
Total length	14·5	34
Length of head and body	3	11
Breadth of head and body	2·5	7
Depth of body	2	4
Greatest depth of tail	1·5	1·5

A large series of this remarkable tadpole and of young frogs was taken by Dr. F. H. Gravely at the edge of a rocky stream on the Cochin hills in September, 1914. He describes the larger individuals (in which the fore limbs had not appeared) as skipping rapidly over damp rocks when disturbed. It is very curious that a frog so closely allied to *R. leptodactyla* and *R. semipalmata* should possess a larva so different, but it is clear that the tadpoles of all these forms are very highly modified.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM:—

17671. Parambikulam, 1700-3200 ft., Cochin State (*F. H. Gravely*).

Rana leptodactyla, Boulenger.

(Plate I, figs. 2, 2*a*, 2*b*.)

Boulenger, *op. cit.*, p. 454.

The tadpole is moderately small; the head and body are moderately stout, oval; the snout is narrowly rounded in front, somewhat constricted laterally, declivous; the eyes are situated far forward, directed forwards and outwards, lateral rather than dorsal, probably very prominent in life; nostrils about half way between eye and tip of snout, further apart than their distance from the eyes; the interorbital breadth nearly twice the internasal; a row of minute white glands runs round the outer and upper margins of the orbit, passing along above the nostril on each side to meet its fellow in the middle line a short distance from the tip of the snout. The spiracle is small, sinistral, situated nearer the dorsal surface than the ventral and nearer the eye than the base of the hind limb. The ventral surface is strongly convex.

The mouth-disk is small, directed downwards and a little forwards, without horny teeth; the upper lip is very distinct, forming a crescentic membrane which can be closed down over the mouth, fringed with short, pointed papillae and bearing two or three rows of similar papillae at its

base just above the upper beak ; the lower lip is divided into five lobes, of which two are lateral in position and much larger than the other three, which occupy the posterior margin of the disk; the upper one-third of these lateral lobes, each of which is half as broad as the upper lip, is capable of being folded backwards ; the three posterior lobes of the lower lip are sub-equal, pointed below and edged with short processes ; similar processes are scattered on the base of the three lobes near the lower beak ; both parts of the beak are slender, the upper beak relatively broader than the lower, which is a little stouter and V-shaped ; both parts are minutely serrated and the upper is entirely black ; the basal part of the lower beak is white.

The tail is powerful, tapering gradually to a rather blunt point; both membranes and muscular part are well-developed, the latter about twice as deep as either membrane at its base, both membranes reaching the posterior extremity of the body.

The dorsal surface of the head and body are yellow, with boldly contrasting black marks, which extend on to the lateral surfaces ; the ventral surface is shaded with black, the pigment being distributed in minute, short hair-like lines ; the colour of the tail is similar to that of the dorsal surface of the head and body.

Measurements of a specimen in which the hind limbs are just making their appearance :—

	mm.
Total length	31
Length of head and body	12·5
Breadth of head and body	7·5
Depth of body	6
Greatest depth of tail	5

I have examined only two specimens of this tadpole. Although they are accompanied by young frogs of the species, as well as by those of *R. semipalmata* and *R. verrucosa*, the series is by no means complete and I rely for the identification rather on circumstantial evidence and on the resemblance between the specimens and those of the larva of *R. semipalmata* than on any more definite grounds.

The specimens were obtained in a small pool at the edge of a jungle-stream in the hills in September. Unfortunately no information is available that would cast light on the peculiar structure of the mouth-parts in this and the next species.

Distribution.—Hills of the southern part of the Malabar zone and the neighbouring districts.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17698. Kavalai, 1300-3000 ft., Cochin State (*F. H. Gravely*).

Rana semipalmata, Boulenger.

(Plate I, figs. 3, 3*a*, 3*b*.)

Boulenger, *op. cit.*, p. 454.

This tadpole closely resembles that of *R. leptodactyla*, from which it differs in the following particulars :—

1. The whole animal is slighter and smaller.

2. The tail is a little longer in proportion to the head and body, its length being more than five times its greatest depth.
3. The upper lip is relatively much broader, being more than three times the breadth of one of the lateral lobes of the lower lip.
4. The beak is relatively broader and stouter.
5. The markings are less conspicuous and the ventral surface is colourless.

Mr. Gravely obtained a complete series of this larva, with many young frogs, in the same circumstances as those in which he found the tadpoles of *R. leptodactyla* and *R. verrucosa*.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17702. Parambikulam, 1700-3200 ft., Cochin State (*F. H. Gravely*).

Nyctibatrachus pygmaeus (Günther).

(Plate I, figs. 5, 5*a*.)

Boulenger, *op. cit.*, p. 467.

The tadpoles are of moderately large size ; the head and body rather narrowly oval, flattened moderately, the ventral surface being distinctly convex ; the snout is rounded, the nostrils rather widely separated, nearer to one another and to the eyes than to the tip of the snout, the distance between them being much more than half the interorbital breadth ; the eyes are dorsal but directed outwards, situated at about one-third the distance between the tip of the snout and the base of the hind limbs. The spiracle is lateral, sinistral, somewhat tubular, pointing upwards and backwards.

The mouth-disk is large and somewhat sucker-like, entirely ventral, but with opposible lips and a lateral emargination on either side. The lower lip is edged with minute finger-like processes, the lateral region of the disk, which is produced in two lobules, is densely covered with similar processes; the upper beak is shallow, broadly U-shaped, entirely black, with smooth or almost smooth margins, the lower beak much narrower, V-shaped, distinctly but minutely serrated on the margins, white at the base for at least half its depth. The dental formula is $2 : 5+5/1+1 : 5$, the three upper tooth-rows being equal and the interruption in the third being very slight ; the five upper tooth-rows of the lower lip are equal and the sixth rather shorter ; the interruption in the first row of this lip is very slight.

The tail is long and slender, narrowly lanceolate, the muscular part relatively deep in the middle, the whole tapering to a fine point ; both membranes arise a considerable distance behind the base of the hind limbs.

The dorsal and lateral surfaces of the head and body are purplish-brown with a few dark spots, becoming paler between the eyes, the ventral surface yellowish, the proximal third of the tail brown with a few dark spots, the distal two-thirds as a rule more deeply pigmented, marbled with purplish-brown and buff or almost entirely of the former colour, the membranes bearing scattered pigment-cells.

Measurements of a specimen with the hind limbs fairly well developed :—

	mm.
Total length	51
Length of head and body	19
Breadth of head and body	10
Depth of body	7
Greatest depth of tail	6

The specimens in the Indian Museum were collected in a small lake in June, 1912. They include a young frog with the tail still unabsorbed.

Distribution.—Anamalai and Nilgiri Hills, South India.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17248. Coonoor, Nilgiri district, Madras (*Capt. R. B. S. Sewell, I.M.S.*)

Species Incertae Sedis.

(Plate I, figs. 6, 6*a*.)

Annandale and Narayan Rao, *Proc. As. Soc. Bengal* (n. s.) XIII, p. clxxxvi (1917).

The tadpole is large ; the head and body massive but flattened, broadly rounded in front, relatively very large ; the eyes and nostrils are situated far back, the latter about half way between the hind limbs and the tip of the snout ; the distance between the nostrils is much less than that between them and the eyes, about half the interorbital breadth ; the eyes are small, entirely dorsal ; the distance from the tip of the snout to the nostrils is more than twice that from nostril to eye.

The ventral surface is flattened. The spiracle is sinistral, laterally tubular, pointing upwards and backwards, situated rather nearer the anus than to the tip of the snout.

The mouth-disk is ventral, transversely oval, sucker-like, surrounded entirely by a margin covered with small rounded tubercles, occupying (when the mouth is open) about one-third of the ventral surface ; the upper and lower lips are not opposible ; the dental formula is 2/3 or 2/1+1 : 2 ; the two upper tooth-rows are equal and a little longer than the three lower rows, which are also equal ; the upper and lower beaks are each in a single piece, rather shallow (especially the lower beak), moderately stout, with their margins very minutely serrated ; they are white with black margin.

The tail is relatively short and feeble, shallow, sharply pointed ; the fin-membranes moderate both above and below, each of about the same depth as the muscular portion in the middle of the tail, the upper membrane commencing some little distance behind the base of the hind legs.

The colour of the dorsal and lateral surfaces is dark grey with small black spots, the tail is marbled with dirty white ; the ventral surface is colourless except for a few scattered pigment-cells.

The anus opens by a transverse slit, which extends right across the base of the tail on to a little flattened leaf-shaped membrane, which extends backwards on the ventral surface and is situated to the right of the middle line.

Measurements of a specimen which has the hind limbs fairly well-developed :—

	mm.
Total length	62
Length of head and body	24
Breadth of head and body	15
Depth of body	9
Greatest depth of tail	8

The inner metatarsal tubercle on the feet makes its appearance at an early stage and is spade-like and very conspicuous, being almost white while the sole of the foot is black.

The pectoral girdle, which has been dissected out from a nearly adult tadpole by Mr. C. R. Narayan Rao, closely resembles that of *Leptodactylus*,[1] except that the sternum is poorly developed, and the frog possibly belongs to the Cystignathidae as we suggested in the paper cited. It is improbable that it belongs to any species of which the adult has been described, and new genus of the family as recorded from India. I thought at first that it was the larva of *Nyctibatrachus major*,[2] but have since received a series of tadpoles and young frogs of that species in hardly good enough condition for description. They are quite different. In some respects this tadpole bears a close resemblance to that of *Heleophryne natalensis*, a South African Cystignathid recently described by J. Hewitt.[3] It differs from those of *Bufo penangensis*[4] and *Bufo asper*[5], both of which have greatly enlarged lips modified to form an organ of adhesion, in that both the lips are equally enlarged, instead of the lower lip being much the greater of the two. The tadpoles in the collection of the Indian Museum were collected in September, 1914 ; they were found clinging to rocks by means of their oral suckers in rapid-running streams in the neighbourhood of waterfalls. The larvae of *H. natalensis* were observed in similar situations in the valley of the Krantz Kloff in October, 1912.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17709. Kavalai, 1,300-3,000 ft., Cochin S ate . . } (*F. H. Gravely*).
17719. Parambikulam, 1,700-3,200 ft., Cochin State }
17720. Forest Tramway, mi. 10-14, 0-300 ft., Cochin }

[1] See Boulenger, *Cat. Batr. Sal. Brit. Mus.* p. 238, fig. (1882).
[2] My *Rana travancorica* (*Rec. Ind. Mus.* V, p. 191 : 1910) is synonymous with *N. major*.
[3] *Ann. Natal Mus.* II, p. 478, pl. xxxix, figs. 5, 6, 7 (1913).
[4] Flower, *Proc. Zool. Soc., London*, 1899, p. 909, pl. lx, figs. 3, 3*a*.
[5] Van Kampen, *Nat. Tijd. Ned. Ind.* LXIX, p. 30, pl. ii, fig. 2.

EXPLANATION OF PLATE I.

SOUTH INDIAN TADPOLES.

Rana verrucosa, Günther.

FIG. 1.—Tadpole, × 2.
,, 1*a*.—Mouth-disk of tadpole with mouth open, × 8.

Rana leptodactyla, Boulenger.

FIG. 2.—Tadpole, × 2.
,, 2*a*.—Mouth-disk of tadpole with mouth open, × 16.
,, 2*b*.—The same with the mouth closed.

Rana semipalmata, Boulenger.

FIG. 3.—Tapdole, × 2.
,, 3*a*.—Mouth-disk of tadpole with mouth open, × 16.
,, 3*b*.—The same with the mouth closed.

Rana beddomei (Günther).

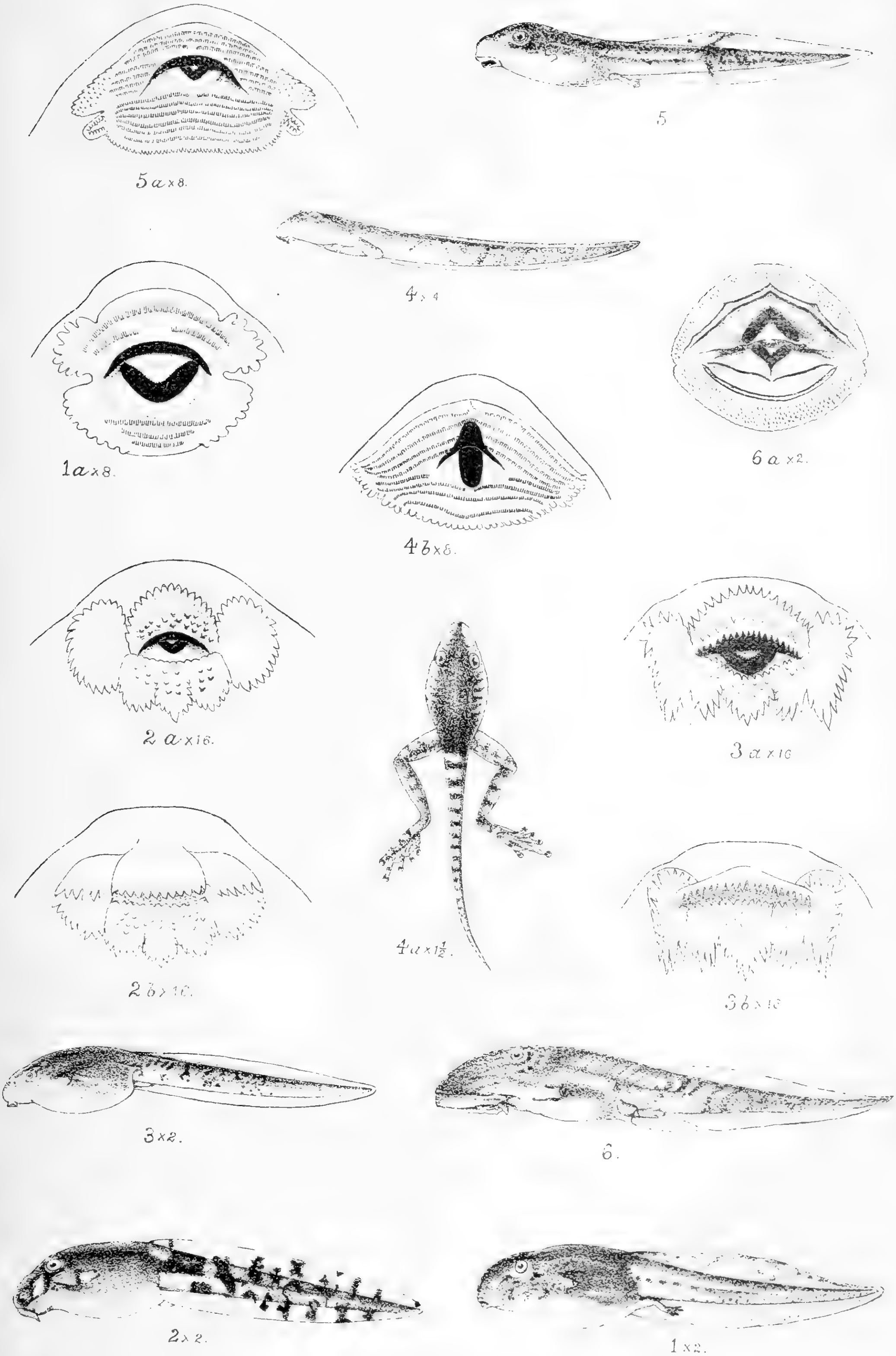
FIG. 4.—Young tadpole, × 4.
,, 4*a*.—Older tadpole, × $1\frac{1}{2}$.
,, 4*b*.—Mouth-disk of tadpole, × 8.

Nyctibatrachus pygmaeus (Günther).

FIG. 5.—Tadpole, × $1\frac{1}{4}$.
,, 5*a*.—Mouth-disk of tadpole, × 8.

Species incertae sedis.

FIG. 6.—Tadpole (nat. size).
,, 6*a* —Mouth-disk of tadpole, × 2.



A. Chowdhary, del. et lith

SOUTH INDIAN TADPOLES.

III. THE TADPOLES OF THE FAMILIES RANIDAE AND BUFONIDAE FOUND IN THE PLAINS OF INDIA.

By N. Annandale, *D.Sc., F.A.S.B., Director, Zoological Survey of India, and* C. R. Narayan Rao, *M.A., L.T., Mysore University, Bangalore.*

(Plate II.)

In his admirable account of the larvae of the European toads and frogs Dr. G. A. Boulenger[1] discussed the differential characters proper to species, genera and families. He was, however, dealing with a fauna comparatively little specialized, in which the Batrachian larvae were not highly modified in correlation with different modes of life. In a short note [2] published in the Proceedings of the fourth meeting of the Indian Science Congress we have pointed out the extreme complexity of evolution in the Indian tadpoles, due both to convergence and to divergence in structure as well as in habits. Before a satisfactory account can be given of those that live in hill-streams and in pools on the Indian plateaux—and the majority of the Indian frogs inhabit hill-jungles—further investigations are necessary, more particularly in Southern India. The tadpoles of the plains, however, living in open country and as a rule in still water, do not exhibit the same diversity of structure or the same degree of specialization. With the exception of a few rare and apparently geographically restricted species such as *Rana strachani* from Malar in Sind and *Rana dobsoni* from Mangalore on the West Coast of Madras, they are well-known ; we have been able to examine fresh or at least fairly well-preserved material of all the species except the two mentioned by name. In the present paper, therefore, we propose to give a succinct taxonomic account of the tadpoles of the great majority of the toads and frogs of the families Bufonidae and Ranidae that are found in the plains of India and Assam ; material is not yet forthcoming that would enable us to deal with the species peculiar to Burma and Ceylon. When good descriptions are already available in readily accessible journals such as the *Proceedings of the Zoological Society of London*, the *Journal of the Bombay Natural History Society*, the *Records of the Indian Museum* or the *Memoirs of the Asiatic Society of Bengal* it is unnecessary, at a time when paper and printing are so expensive, to duplicate them. We have, therefore, contented ourselves with a reference and such explanatory remarks as seem necessary. Our object is merely to facilitate future work on the anatomy and bionomics of the species.

Animals so soft as tadpoles, even when preserved with great care, are very apt to be distorted owing to pressure or shrinkage. We have, therefore, relied in our descriptions on definite structural characters, such as those connected with the mouth, rather than on comparative

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[1] *Proc. Zool. Soc. London*, pp. 593-626, pls. xlv-xlvii (1891).
[2] *Proc. As. Soc. Bengal* (n. s.) 1917, p. clxxxv.

measurements or proportions, except when the differences are very great. In dealing with certain tadpoles, however, especially those of the genus *Bufo*, it is often impossible to find differential structural characters, and we have been obliged to accept less satisfactory methods of diagnosis. The larva of each species has probably a characteristic appearance in life, but the differences are hard to define and often somewhat evanescent. Allowance must be made for these facts in naming specimens.

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Our references under the name of each species are to descriptions of or notes on the larva.

KEY TO THE FAMILIES OF BATRACHIAN LARVAE FOUND IN THE PLAINS OF INDIA.

I. Mouth-disk more or less developed; transverse rows of horny teeth usually, and an upper and lower horny beak always present; spiracle on the left side.	
A. Anus (in the natural position) directed towards the right	RANIDAE.
B. Anus (in the natural position) directed backwards .	BUFONIDAE.
II. Mouth-disk not developed; no horny teeth or beak; spiracle in the mid-ventral line	ENGYSTOMATIDAE.

In using this key care must be taken that the anus is correctly identified and that its natural position is ascertained. In some species of Ranid larvae its dextral direction is not very strongly marked, while in the Bufonidae it is usually situated at the end of a more or less tubular sheath which is apt to be twisted *post mortem* to one side or the other. The only Ranid larva likely to be found in the plains of India in which the horny teeth are absent is that of *Oxyglossus lima*, a species said to occur in Bengal. In the tadpole of this genus the mouth-disk is very feebly developed and the closed mouth appears as a vertical slit.

The Engystomatidae will be dealt with in another paper (pp. 41-45, *postea*).

Family RANIDAE.

It does not seem possible (except in the case of *Oxyglossus*, the tadpoles of which differ from those of all other Ranidae[1] in the vestigial character of the upper lip and in the absence of horny teeth on the mouth-disk) to distinguish the larvae of the different genera of this family.

KEY TO THE RANID LARVAE FOUND IN THE PLAINS OF INDIA.

I. Mouth-disk poorly developed; lower lip horseshoe-shaped; no horny teeth . . . . . . *Oxyglossus lima.*

II. Mouth-disk well-developed; at least three transverse rows of teeth (as a rule at least one of them interrupted in the middle-line) present on the disk.

A. Three rows of teeth on the mouth-disk.

1. Beaks shallow; long finger-shaped processes on the lower lip . . . . ? *Rana brevipalmata.*

2. Beaks stout; processes on lower lip short.

(*a*) Habit stout; tail spotted with black, not more than twice as long as head and body . . *R. cyanophlyctis.*

(*b*) Habit rather slender; tail without black spots, more than twice as long as head and body . *R. hexadactyla.*

B. More than three transverse rows of teeth on disk.

1. Five transverse rows of teeth on disk.

(*a*) Habit very stout; snout broadly rounded; fringe on margin of lower lip widely interrupted in the middle line . . . . *R. breviceps.*

(*b*) Habit slender; snout bluntly pointed; fringe on margin of lower lip not or slightly interrupted.

(i) Dorsal profile of tail strongly sinuate; fringe on margin of lower lip papilliform, uninterrupted . . . . *R. limnocharis.*

(ii) Dorsal profile of tail not sinuate; fringe on margin of lower lip digitiform, slightly interrupted in the middle . . . . *R. tytleri.*

2. Seven rows of teeth on mouth-disk . . . *Rhacophorus maculatus.*

3. More than seven rows of teeth on mouth-disk.

(*a*) Interior of mouth inside beaks armed with a horny plate on the palate and a horny tubercle on each side; not more than five tooth-rows on upper-lip; lips rather feebly developed.

(i) Abdomen nearly flat . . . . . . *Rana tigrina.*

(ii) Abdomen distinctly convex . . . . *R. crassa.*

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[1] In those of two species of *Rana* from the hills of Southern India there are no horny teeth, but the disk and beaks are well developed. See pp. 19, 20 of this volume.

(*b*) Interior of mouth unarmed; seven rows of teeth on upper lip.
- (i) Lips enlarged, forming a cup-like structure . *R. sternosignata.*
- (ii) Lips not enlarged . . . . . . *Rhacophorus malabaricus.*

Oxyglossus lima, Gravenh.

1916. *Oxyglossus lima*, Smith, *Journ. Nat. Hist. Soc. Siam*, II, p. 173, pl.

An excellent description of this peculiar tadpole has recently been given by Smith in the paper cited, which is not always accessible to naturalists in India. As we have not been able to examine fresh specimens, we quote his description.

"Head and body, length twice, or nearly twice its breadth, snout long, obtusely pointed. Nostrils equidistant between the eyes and the tip of the snout. Eyes towards the upper surface of the head, looking outwards and upwards, twice as far apart as the nostrils. Spiraculum sinistral, directed straight backwards, nearer the vent than the eye, long and prominent in life. Anal tube very short, median. Mouth small, terminal, without papillae; lower lip vertically horse-shoe shaped, upper lip, a small rounded flap; no teeth; beak entirely black, lower mandible deeply semilunar in shape. The lower lip, which occupies the greater part of the mouth, itself projects from a sheath of skin, which is formed by, and is part of, the skin of the rest of the body.

Tail sharply pointed, very high at its commencement where it rises almost abruptly from the base of the tail, diminishing gradually as it passes backwards; at its highest point about four times as deep as the lower crest, which is very shallow. Toes webbed as in the adult.

Colour (*in life*).—Light olive above, with darker markings; a dark streak through the eye passing backwards, and dark patches at the base of the tail. Caudal membranes handsomely veined and marbled with shades of brown. Below, white.

Dimensions.—Total length, 33 mm., head and body 11.

A feature of the tadpole is its high, festooned upper crest, which gives it a very handsome appearance."

Geographical distribution.—The species is said to occur in Bengal, but it is doubtful whether it is to be found in the plains. Boulenger (*Faun. Malay Penin.*, *Rept.*, p. 225) gives the distribution as "Bengal and Southern China to the Malay Archipelago."

Smith's tadpoles were from Siam.

Specimens of larvae in the collection of the Indian Museum:—

18291. Bangkok, Siam. Dr. Malcolm Smith.

? **Rana brevipalmata**, Peters.

? 1904. *Rana limnocharis*, Ferguson, *Journ. Bombay Nat. Hist. Soc.*, XV, p. 501, pl. A., fig. 3.
1917. ? *Rana brevipalmata*, Annandale, *Mem. As. Soc. Bengal* VI, p. 134, ? pl. vi, fig. 5.

There is considerable doubt as to the tadpole of this species, which appears to be found both in Pegu and Tenasserim to the east and in the Malabar Zone to the west of India. Without further material than we possess it is useless to attempt to give a detailed description.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17708. Chalakudi, Cochin State. Dr. F. H. Gravely.
17730. Kawkareik, Amhrst district, Tenasserim. Dr. F. H. Gravely.

Rana cyanophlyctis, Schneider.

(Plate II, fig. 1.)

1895. *Rana cyanophlyctis,* Anderson, *Proc. Zool. Soc. London,* 1895, p. 660, pl. xxxvii, fig. 2.

An excellent description and figures of Arabian specimens of this tadpole were given by the late Dr. J. Anderson in the paper cited above. Through the kindness of Dr. Boulenger we have been able to compare some of these specimens with Indian examples. They are larger and stouter than any we have seen from this country, but there is considerable difference in this respect between specimens from different Indian localities.

The tadpole may be distinguished from all other Oriental larvae with which we are acquainted, except that of *Rana hexadactyla*, by the arma-

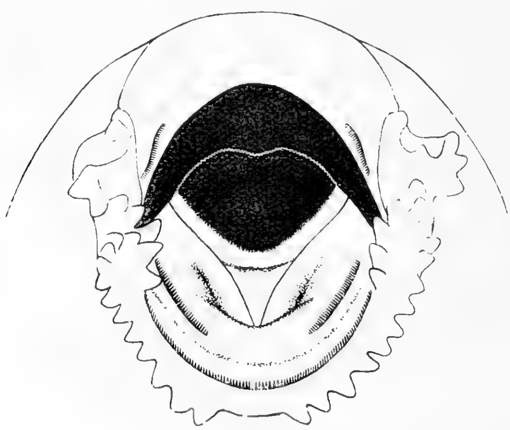

FIG. 1.—Mouth-disk of a tadpole of *Rana cyanophlyctis* with the upper tooth-row greatly reduced (considerably enlarged).

ture of its mouth. Its beak, though stouter than that of most species, is less stout and less prominent than that of the tadpole of *Rana corrugata*,[1] in which there is no horny pad on the mouth-disk below the beak. The condition of the inner row of teeth on the upper lip is variable. Sometimes it extends right across the disk, but it is usually interrupted more or less broadly in the middle line. Occasionally it is almost completely absent.

Full-grown Indian specimens are usually about 65 to 75 mm. long; the tail is less than twice as long as the head and body; its dorsal membrane rises more or less abruptly a little in front of the posterior extremity of the body, and the top of the head is flat.

[1] *Mem. As. Soc., Bengal,* VI, pt. 11, p. 149, fig. 7A and B.

Measurements of full grown specimens with the hind legs well-developed :—

	A.	B.
	mm.	mm.
Total length	65	71
Length of head and body	24	25
Breadth of head and body	15	14
Greatest depth of tail	17	14

Specimen A is from an island in the Chilka Lake, specimen B from Kashmir.

Geographical distribution of the species.—The species occurs in Baluchistan and all over India proper : also in Southern Arabia, Ceylon and the northern part of the Malay Peninsula. It ascends the Himalayas to a height of at least 6,000 ft.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

16532. Hardramaut, South Arabia. Brit. Mus. (Ex.).
18281. Kashmir. Col. H. T. Pease, I.C.V.D.
17247. Junagara, Kathiawar. S. P. Agharkar.
17736. Rausali, Naini Tal district., W. Himalayas. Mus. Coll.
17737. Kalka, alt. 2,400 ft., base of Simla Hills. Mus. Coll.
17739. Mirzapur, United Provinces. Mrs. Johnstone.
17194. Marihan, Mirzapur district, United Provinces. Capt. R. B. S. Sewell, I.M.S.
17740. Hamirpur Road, United Provinces. J. W. Caunter.
17735. Chupra, Saran district, Bihar. M. Mackenzie.
17738. Puri, Orissa. Dr. N. Annandale.
18470. Barkuda Island, Chilka Lake, Ganjam district, Madras. Dr. N. Annandale.

Rana hexadactyla, Lesson.

(Plate II, figs. 2, 2*a*, 2*b*.)

1904. *Rana hexadactyla*, Ferguson, *op. cit.*, p. 500, pl. A., fig. 2.

In structure this tadpole resembles that of *Rana cyanophlyctis*, but it is much smaller and more slender and has the tail shallower and longer in proportion, the snout is more produced and the mouth is rather smaller, with the beak shallower. There is a deep groove, with its sides and base sometimes cornified, across the lower lip ; the margin of the upper beak fits into this groove when the mouth is shut. There are no dark spots on the tail, the ventral surface of the head and body is silvery and there are usually silvery spots on the sides of the head, body and tail. The colouration is, however, variable.

Measurements of a specimen in which the hind legs are not quite fully developed :—

	mm.
Total length	35
Length of head and body	12
Breadth of head and body	6
Greatest depth of tail	7

Geographical distribution of the species.—South Peninsular India and Ceylon. The most northern record with which we are acquainted is from Puri in Orissa.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17722. Puri, Orissa Coast. Dr. N. Annandale.
17726. Madras (town). Museum Coll.
17665-66. Chalakudi, Cochin State. Dr. F. H. Gravely.
17727. Kandy, Ceylon. Dr. F. H. Gravely.

Rana breviceps, Schneider.

1904. *Rana breviceps*, Ferguson, *op. cit.*, p. 502, pl. B., fig. 1.
1915. *Rana breviceps*, Narayan Rao, *Rec. Ind. Mus.*, XI, p. 34, figs. 2A, 2B.

This tadpole has been described by Ferguson and by Narayan Rao, who points out certain differences between the specimens examined by him and those described by the former author.

Geographical distribution of the species.—The Punjab (including the Kashmir Valley) ; the Himalayas up to 7,000 ft. ; the Indo-Gangetic plain ; Peninsular India ; Assam.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

16534. Trivandrum, Travancore. Brit. Mus. (Ex.).
16633. Bangalore, South India. C. R. Narayan Rao.
17676. Coorg, South India. C. R. Narayan Rao.

Rana limnocharis, Weigm.

1909. *Rana limnocharis*, van Kampen, *Natuurh. Tijdsch. Ned.-Ind.*, LXIX, p. 35.
1916. *Rana limnocharis*, Smith, *op. cit.*, pp. 165-166.
1917. *Rana limnocharis*, Annandale, *Mem. As. Soc. Bengal* VI, p. 132, figs. 2B, (p. 124), 3B (p. 132), pl. vi, fig. 2.

Tadpole usually small, but variable in size ; head and body broadly oval, somewhat depressed, snout bluntly pointed, declivous ; nostrils as seen from above much nearer tip of snout than to eyes, the distance between them not quite half that between the eyes ; interorbital space about as wide as distance between eye and nostril ; eyes lateral, directed outwards, but protruding above in the living animal. Spiracle tubular, its opening hardly below the level of the eye, nearer to the eye than to the posterior extremity of the body. Ventral surface slightly convex.

Mouth-disk small, transverse ; upper lip edged with teeth, lower lip, the lateral lobes of which are not well developed, with papillae. Dental formula 1 : 1+1/13, the uppermost tooth-row much the longest, the first and second rows on the lower lip sub-equal ; beak black, slender, not serrated on the margins, the upper part V-shaped, with a distinct convexity in the middle, the lower part simply V-shaped.

Colouration whitish, more or less densely covered with black pigment-cells on the dorsal and lateral surfaces of the head and body and a more or less distinct dark Y-shaped mark on the top of the head. Ventral surface almost colourless ; tail whitish blotched with black.

Tail relatively slender, sharply and gradually pointed, with the membranes particularly well-developed ; dorsal membrane arising almost on a level with the posterior extremity of the body, distinctly deeper than the lower membrane, its margin sinuous.

Measurements of a large specimen with the hind legs well-developed :—

	mm.
Total length	51
Length of head and body	17·5
Breadth of head and body	10
Greatest depth of tail	8·5

Geographical distribution of the species.—The plains of India; the Himalayas up to 7,000 ft.; Burma up to 6,000 ft.; Siam; China; Japan; the Malay Peninsula and Archipelago.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17265-73[1]. Gangtok, 6,150 ft., Sikkim. Museum Coll.
17729. River Tista, Jalpaiguri district, East Bengal. Dr. N. Annandale.
17724. Mirzapur, United Provinces. Mrs. Johnstone.
17723. Khemsa, 2,650 ft., Bombay Presidency. S. P. Agharkar.
17732. Nechal, Western Ghats, Satara district. Dr. F. H. Gravely.
17721. Madras (town). Dr. J. R. Henderson.
18303. Prae, Siam. Dr. Malcolm Smith.
16268. Batavia, Java. Dr. P. N. van Kampen.

Rana tytleri (Theobald).

(Plate II, figs. 3, 3*a*.)

Tadpole moderately large, but of graceful shape; head and body narrowly ovoid, flattened above but not depressed; snout rather broadly rounded, slightly declivous; eyes lateral, but situated close to the dorsal surface; nostrils situated nearer the tip of the snout than the eyes, the distance between them much less than the interorbital space or the distance from eye to nostril. Spiracle tubular, directed upwards and backwards, situated much nearer eye than to posterior extremity of the body; throat somewhat flattened, abdomen convex.

Mouth-disk small, pointing forwards rather than downwards, distinctly transverse; the upper lip nearly straight, edged with teeth; the lower lip with a distinct lateral lobe on either side, which is constricted in the middle; the lateral lobes edged with rather broad and blunt papillae, which extend inwards at the constriction; the posterior lobe fringed with two rows of finger-like processes, which are interrupted for a short distance in the middle; dental formula 1 : 1+1/3 or 1 : 1+1/1+1 : 2; the anterior tooth-row relatively broad; the two halves of the divided row on the upper lip very short and widely separated; first and second rows on the lower lip sub-equal, third row much shorter; the first row on this lip very slightly interrupted, perhaps by accident; beak wide and shallow, both the upper and the lower parts white, with black edges; the middle part of the upper beak almost straight.

Tail powerful, of graceful shape, sharply pointed, with both muscular and membranous portions well-developed; dorsal membrane arising well in front of the posterior extremity of the body, the dorsal and ventral margins almost straight and parallel for the first half of their

[1] Possibly these specimens represent a distinct local race.

length, then approaching one another rather abruptly. Anus directed to the right.

Dorsal and lateral surfaces chestnut-brown ; a dark longitudinal streak extending back along the body from the eye, edged with white above ; ventral surface of throat chestnut-brown, of abdomen whitish ; tail with small white and dark brown spots.

Measurement of a specimen with the hind legs well-developed :—

	mm.
Total length	61
Length of head and body	21
Breadth of head and body	12·5
Greatest depth of tail	11·5

We have seen a single specimen of this tadpole, which one of us obtained in June, 1911, together with a tadpole of *R. limnocharis*, in a small weedy pool some miles from the base of the Eastern Himalayas near Siliguri. The hind legs are well developed and agree with those of the type specimen of *R. tytleri*, the only species found in the district to which this larva could belong.

The tadpole somewhat resembles that of *R. limnocharis*, from which it is easily distinguished by its colouration, by the shape of its tail and by the formation of its mouth-disk.

Rana tigrina, Daud.

1917. *Rana tigrina*, Annandale, *Mem. As. Soc. Bengal*, VI, p. 125, fig. 2A, pl. vi, figs. 1, 1*a*.

The tadpole of this species has recently been described and figured from living specimens by Annandale. Attention may, however, be directed to an error in his account of the mouth-disk. The dental formula of the lower lip in normal specimens is usually 2+2 ; 2 or 3+3 : 2 and the third row of teeth appears to be divided only in degenerate specimens. In individuals kept in captivity some or all of the teeth on both lips are apt to disappear.

Measurements :—

	A. mm.	B. mm.	C. mm.
Total length	35	45	50
Length of head and body	13·5	16	16
Breadth of head and body	8	9·75	11
Greatest depth of tail	5·5	8	6·5

Specimen A is from Calcutta and has the hind legs about half developed. Specimen B is from Damukdia Ghat on the Ganges, and has the hind legs in almost the same condition as specimen A. Specimen C is from Khoolna in the Gangetic delta and has the hind legs fully developed.

We give here for comparison measurements of tadpoles of the closely related species *Rana rugulosa* (from Bangkok, Siam) and *R. crassa* (from Madras). In both cases the hind legs are fully developed.

Measurements :—

	R. rugulosa.	*R. crassa.*
	mm.	mm.
Total length	62·5	68·5
Length of head and body . . .	22·5	24·5
Breadth of head and body . . .	14·5	16
Greatest depth of tail	12	11·5

Geographical distribution of the species.—The plains of the whole of Northern and Peninsular India, with the exception of a few localities in Madras ; the Nepal Valley ; Assam ; Burma and Yunnan.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17733. Siliguri, base of East Himalayas. J. B. Richardson.
16096. Damukdia Ghat, River Ganges, Bengal. R. H. Hodgart.
15718. Sara Ghat, River Ganges, Bengal. R. H. Hodgart.
16097. Khoolna, Eastern Bengal. J. W. Caunter.
17162-8, 9004. Calcutta Dr. Jerdon.
10803-10810-11. No history.

Rana crassa, Jerdon[1]

Boulenger [2] has recently shown that this frog, which he regards as a variety of *R. tigrina*, is at any rate racially distinct. It is distinguished by its very short hind limbs and by the peculiar structure of the internal metatarsal tubercle.

The tadpoles differ from that of the true *R. tigrina* in the following particulars :—

They are larger and of stouter build, with the abdomen more convex ; the dorsal surface is more densely pigmented and there is a pale band extending backwards in an oblique direction from the nostril to a pale space surrounding the eye. This band probably covers a glandular channel.

The tadpole very closely resembles that of *R. rugulosa*, Wiegmann,[3] except that the dorsal membrane of the tail is not so elevated and that the colouration of the dorsal and lateral surfaces of the head and body are less uniform.

We have been able to examine only two tadpoles that can be assigned to this species. In one of them the hind legs are fairly well-developed, while in the other the toes are already differentiated.

Geographical distribution of the species.—The frog is said to occur to the exclusion of the true *Rana tigrina* in the immediate neighbourhood of the town of Madras. Jerdon gives its distribution as " a few tanks in the Carnatic " and Boulenger records specimens from Benares as well as from various localities in South India and Ceylon. There are specimens in the Indian Museum from Colombo, Madras, Chandbally in Orissa and Agra in the United Provinces.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17734. Madras (town). Dr. J. R. Henderson.

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[1] *Rana crassa*, Jerdon, *Journ. As. Soc. Bengal*, XXII, p. 531.
[2] *Rec. Ind. Mus.*, XV (1918).
[3] *R. tigrina*, Flower, *Proc. Zool. Soc. London*, p. 891, pl. lix, figs. 2, 2*a* (1899).

Rana sternosignata, Murray.

The tadpoles of this species that we have examined are not in good condition. In general facies they appear to resemble those of *Rana pleskii* [1] but the build is stouter and the head and body are distinctly broader and probably flatter. The mouth-disk is transverse, and large ; the margin of the upper lip is beset with horny teeth except at its lower extremities, which bear a double or triple row of elongate tubercles. A similar fringe of somewhat larger tubercles runs round the edge of the lower lip and there is also at its upper extremity, near the ends of the tooth-rows, a patch of similar structures. There are about seven rows on the upper lip and three on the lower lip ; the most anterior of the latter is usually divided in the middle, while the others are complete. The nostril is nearer the tip of the snout than to the eye. The spiracle is nearer to the eye than to the posterior extremity of the body. It is prominent and tubular and is situated about half way up the left side. The anus, which is provided with a large triangular flap, is distinctly dextral. The tail, which is acutely pointed, is apparently more than twice as long as the head and body and has both the muscular and membranous portions well-developed. The upper tail membrane commences as a low ridge above the posterior extremity of the body. Specimens in which the legs are beginning to appear are at least 75 mm. long. The tail is apparently marked with large black or brown blotches, but no detailed description of the colouration can be given.

Geographical distribution of the species.—Kashmir at moderate altitudes ; Baluchistan ; Sind.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

14719. Quetta. Major C. G. Nurse

Rhacophorus maculatus (Gray).

1912. *Rhacophorus maculatus*, Annandale, *Rec. Ind. Mus.* VIII, p. 14.

This tadpole is an extremely variable one. It seems to be readily affected by life in different types of environment and to become much paler and smaller in muddy water. It is possible that differences due to environment are greater than racial differences. Three local races of the species are distinguished by Annandale.

Geographical distribution :—

1. *Rhacophorus maculatus* (Günther) (*forma typica*).—Peninsular India and Ceylon.
2. *Rhacophorus maculatus himalayensis*, Annandale.—The Eastern Himalayas, Assam, Western China.
3. *Rhacophorus maculatus leucomystax* (Gravenhagen).—Lower Burma, Tenasserim, the Malay Peninsula and the Malay Islands ; ? Bengal east of the Bay (Chittagong).

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[1] Annandale, *Rec. Ind. Mus.*, II, p. 345 (1908) and XIII, p. 417, figs. 1,2 (1917).

Flower's [1] excellent description of the tadpoles from Bangkok applies to some Indian specimens.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

Rhacophorus maculatus (Günther).

16461. Sukna, base of Eastern Himalayas. Museum Coll.
17717. Balighai, near Puri, Orissa. Dr. N. Annandale.
17767. Madras (Museum compound). Dr. J. R. Henderson.
18295. } Bangalore, South India. { C. R. Narayan Rao.
17718. } Bangalore, South India. { Dr. N. Annandale.
12607-10. Calcutta Zoological Gardens. Dr. J. Anderson.

Rhacophorus maculatus himalayensis, Annandale.

17774. Pashok, Darjeeling district, Eastern Himalayas, alt. 2,500-3,500 ft. Dr. F. H. Gravely.
16098. }
17706. } Kurseong, 5,000 ft., Eastern Himalayas. Museum Coll., Dr. N. Annandale.
17068. }

? *Rhacophorus maculatus leucomystax*, Gravenhagen.

18267. Rangamati, Chittagong Hill Tracts, Bengal. R. Hodgart.

Rhacophorus malabaricus, Jerdon.

1904. *Rhacophorus malabaricus*, Ferguson, *op. cit.*, p. 503, pl. B, fig. 3, pl. C.

We have no personal acquaintance with the tadpole, which has been described and figured by Ferguson.

Geographical distribution of the species.—Southern part of the Malabar zone and the forests of Mysore.

Family BUFONIDAE

KEY TO THE BUFONID LARVAE FOUND IN THE PLAINS OF INDIA.

I. Colour almost uniform black or brown; only slightly paler on the fin-membranes and ventral surface.
 A. Nostril half as large as eye . . . . . *Bufo fergusoni.*
 B. Nostril less than half as large as eye. . . *Bufo melanostictus.*
 C. Nostril more than three-fourths as large as eye . *Bufo microtympanum.*
II. Colour more or less mottled or speckled; ventral surface distinctly paler than dorsal surface, at any rate anteriorly.
 1. Dorsal profile of tail with a low and gradual convexity; habit rather slender; dorsal surface of head and body with minute white specks . *Bufo stomaticus.*
 2. Dorsal tail fin elevated immediately behind the body; habit stouter; colouration dark . . *Bufo viridis.*

The only genus known from the plains of India is the universally distributed genus *Bufo*. The tadpoles of most species of this genus resemble one another very closely and can only be distinguished by slight differences in proportions, in colouration and in the relative lengths of the rows of teeth on the disk. In all those found in the plains

[1] Flower, *Proc. Zool. Soc. London*, 1896, p. 905, pl. xliv, fig. 2.

of India the dental formula is either 2/3 or 1+1 : 1/3, the lips are poorly developed and only tuberculate on the lateral margins, and the beaks are weak. In two Oriental species that live in hill-streams, *viz.*, *Bufo asper* [1] and *Bufo penangensis*, [2] however, the lips are greatly enlarged and modified to form an apparatus for clinging to rocks.

So far as the species of the plains are concerned it is difficult to distinguish the larvae specifically unless extremely well-preserved material is available. The tadpole of *Bufo melanostictus*, however, and that assigned provisionally to *B. fergusoni* can be separated from those of *B. stomaticus* and *B. viridis* by their uniform colouration. *B. fergusoni* apparently occurs only in the southern part of the Peninsula and it is doubtful whether *B. viridis* descends into the plains at all ; if so, it only does so in the north-west. Any black Bufonid tadpole from the Indo-Gangetic plain or the northern part of Peninsular India is, therefore, almost certain to be that of *B. melanostictus*.

Bufo melanostictus, Schneider.

1896. *Bufo melanostictus*, Flower, *Proc. Zool. Soc. London*, 1896, p. 911, pl. xliv, fig. 3.
1899. *Bufo melanostictus*, *id.*, *ibid.*, p. 910.
1906. *Bufo melanostictus*, Annandale, *Journ. As. Soc. Bengal*, II, p. 289.

Flower has published an admirable description of the tadpole. His figure also is good, but is considerably larger than the normal size. Individuals, however, sometimes grow very large in abnormal conditions.

The toad is found all over the Oriental Region.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

16104. Naini Tal, Western Himalayas. R. Hodgart.
17784. Patari, Naini Tal district, Western Himalayas. Museum Coll.
17794. Mashobra, Simla Hills, Western Himalayas. Baini Parsad.
17750. Bhim Tal, alt. 4,450 ft., Western Himalayas. S. W. Kemp.
17746. Tista River, 4,500 ft., Eastern Himalayas. Dr. L. L. Fermor.
17747. Jalpaiguri (Tista River), North Bengal. Dr. N. Annandale.
17999. Sevok, Darjeeling district, Eastern Himalayas. H. E. Lord Carmichael.
17751. Lucknow, United Provinces. S. W. Kemp.
17753. Siripur, Saran, Bihar. M. Mackenzie.
17752. Calcutta. Dr. B. L. Chaudhuri.
17754. Tribeni, Gangetic delta. Dr. B. L. Chaudhuri.
17755. Madras (town). Dr. N. Annandale.
16102. Mandalay, Upper Burma. Dr. N. Annandale.
18479. Old Valley of Kalaw River, East of Ngot, *ca.* 3,500 ft., Southern Shan States. Dr. F. H. Gravely.
18178. Singgora, Siam. Dr. N. Annandale.

Bufo fergusoni, Boulenger.

(Plate II, figs. 4, 4*a*.)

We assign provisionally to this species a number of tadpoles from small pools on the Travancore coast, where the toad is abundant. These tadpoles are very like those of *Bufo melanostictus* but smaller, of brownish instead of blackish colour and with the nostrils relatively much

[1] Van Kampen, *Natuurh. Tijdsch. Ned-Ind*, LXIX, p. 30, pl. ii, fig. 2 (1909).
[2] Flower, *Proc. Zool. Soc. London*, 1899, p. 908, pl. lx, fig. 3, 3*a*.

larger. The teeth also are smaller, especially on the last row on the lower lip, and the beak even less powerful and with the margin of the upper part nearly straight. Our specimens are not in sufficiently good condition to provide material for a detailed statement as to proportions but we believe that our figure gives an adequate idea of the outline.

Geographical distribution of the species.—Plains of Southern India and Ceylon.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

17771. Varkallai, Travancore. Dr. N. Annandale.

Bufo microtympanum, Boulenger.

The tadpoles can be recognised by the obcardate body whose greatest width is about the pectoral region. The snout slopes, is blunt and rounded. The eyes and nostrils are dorso-lateral in position ; the latter nearly five-sixths as long as the eye, looking upwards and outwards. The internasal space equals the distance between the nares and eyes and the width of the mouth. The mouth is fairly large, the lower lip being better developed. The papillae are confined to the corner of the mouth and slightly extend to the margin of the lips. Dental formula 1 : 1+1/3. The three series on the lower disc are subequal. The skin is smooth. A preorbital or lachrymal gland may be frequently present, as also series of sensory pits on the dorsum and about the flanks of the body. A frontal gland is faintly marked. The spiraculum is a conspicuous tube, visible from below, directed backwards, nearer to vent. The length of the tail slightly more than $3\frac{1}{2}$ times the total depth. The dorsal lobe is more strongly arched, the tip rounded. The colour of the dorsal surface is deep black, the throat bronzed. The abdomen and fin membranes are white, immaculate.

The following are the dimensions of a fully grown larva :—

	mm.
Total length	27
Length of head and body	11
Length of tail	16
Maximum breadth of body	8
Maximum depth of body	5
Maximum depth of tail	5

Geographical distribution of the species.—Fairly common in southern Peninsular India.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

18736. Bangalore, South India. C. R. Narayan Rao.

Bufo stomaticus, Lütken.

(Plate II, figs. 5, 5*a*.)

A series of tadpoles and toads from Rawalpindi in the north of the Punjab belong to this species.

The tadpoles are very small, not exceeding 20 mm. in length when full grown. The head and body are moderately flat, rather narrowly

oval in shape ; the snout is narrowly and evenly rounded ; the nostrils are large and situated about half way between the eye and the tip of the snout. The spiracle is situated at some considerable distance behind the eye. The mouth is ventral ; the dental formula is 1 : 1+1/3, the lower row on the upper lip being moderately interrupted ; the teeth are rather long and of a black colour ; the margin of the upper beak is feebly convex and minutely denticulate. The lower beak, which is situated far within the upper, is broad and almost U-shaped, with its margin minutely serrated. The tail, which is less than twice as long as the head and body, is bluntly pointed and has both the fin-membranes well developed. The upper membrane starts in front of the posterior extremity of the body and rises rather gradually.

The dorsal surface of the head and body is dark, densely covered with silvery white and black dots. The fleshy part of the tail is mottled with dark markings and is darker above than below. The fin-membranes are almost colourless, but with a few scattered black and white pigment-cells. The ventral surface is colourless, but densely covered with minute silvery dots.

The specimens on which this description is based agree very closely with Anderson's description and figures of the larva of *B. andersoni* from Arabia, except that the first row of teeth is not divided—a probable abnormal condition. It is very doubtful whether the two species are distinct. Specimens of toads from India assigned to *B. andersoni* are certainly identical with the species from Eastern Bengal named *Bufo stomaticus* by Lütken, [1] whose name has priority.

Geographical distribution of the species.—Bufo stomaticus is found all over the Indo-Gangetic plains ; in the Western and Eastern Himalayas up to an altitude of at least 6,000 ft. in Nepal, and occasionally in those parts of Bengal and Bihar that lie south of the Ganges Valley. Sclater's record [2] of specimens from Burma was apparently based on a wrong identification.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

18526. Rawalpindi, Punjab. R. Hodgart.

Bufo viridis, Laur.

1891. *Bufo viridis*, Boulenger, *Proc. Zool. Soc. London*, 1891, p. 612, pl. xlvi, fig. 5.
1899. *Bufo viridis*, Bolkay, *Ann. Mus. Nat. Hung.*, VII, pp. 85 and 106, pl. i, fig. 5.

It is doubtful whether this Palaearctic species is found in the plains of India, but it is common in the Kashmir Valley and in many districts north and west of the Punjab. An excellent description is given by Boulenger in his account of the European tadpoles. Specimens from Srinagar agree in every respect with this description.

SPECIMENS OF LARVAE IN THE COLLECTION OF THE INDIAN MUSEUM :—

18473. Srinagar, Kashmir. F. J. Mitchell.

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[1] Lütken (1862) ? See also Boulenger, *Ann. Mag. Nat. Hist.* (6), VII, p. 463 (1891). and Annandale, *Rec. Ind. Mus.*, III, p. 283 (1909).

[2] *Proc. Zool. Soc. London*, 1892, p. 347.

EXPLANATION OF PLATE II.

Rana cyanophlyctis, Schneider.

Fig. 1.—Tadpole from Barkuda I., Chilka Lake (nat. size).

Rana hexadactyla, Lesson.

Fig. 2.—Tadpole from Cochin, × $1\frac{1}{2}$.
,, 2*a*.—Mouth-disk of tadpole with mouth open, × 16.
,, 2*b*.—The same with the mouth closed.

Rana tytleri (Theobald).

Fig. 3.—Tadpole from northern Bengal (nat. size).
,, 3*a*.—Mouth-disk of tadpole, × 8.

Bufo fergusoni, Boulenger.

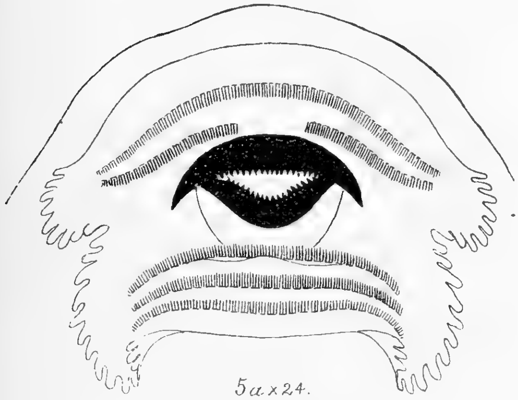
Fig. 4.—Tadpole from Travancore, × 4.
,, —Mouth-disk of tadpole, × 30.

Bufo stomaticus, Lütken.

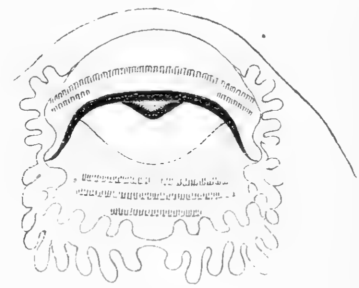
Fig. 5.—Tadpole from the Punjab, × 4.
,, 5*a*.—Mouth-disk of tadpole, × 24.

4.

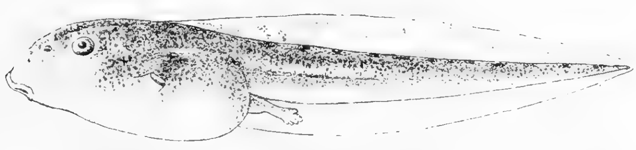
4 a×30.



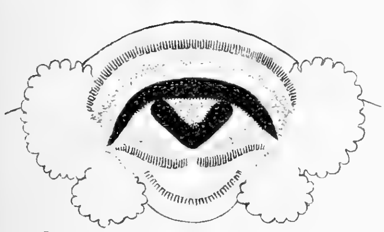
5 a×24.



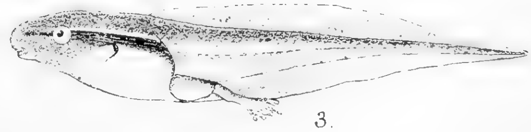
3 a×8



5×4.

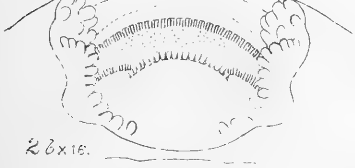


2 a×16.



3.

2×1½.



2 b×16.

1.

A. Chowdhary & S. C. Mondul, del. A. Chowdhary, lith.

INDIAN TADPOLES.

IV. NOTES ON THE TADPOLES OF INDIAN ENGYSTOMATIDAE.

By C. R. NARAYAN RAO, *M.A.*, *L.T.*, *Mysore University*, *Bangalore.*

The main object of this paper is to bring together all that is known about the larvae belonging to this family found in India and the Malay Peninsula, in order to facilitate further investigation being undertaken. Of the species reported to occur in India, Burma, and the Malay Peninsula, the life-history of only ten species has been worked out and it is the experience of herpetologists that to obtain the larvae of some of these and other forms is by no means easy, owing to the special modes of life adopted by the great majority of them. I am indebted to Dr. Annandale for the courtesy of allowing me to examine the tadpoles belonging to the species *Microhyla achatina*, ? *M. berdmorei* and *Kaloula pulchra* contained in the Indian Museum collection. The larvae of eight species have been described and annotated by different authors and only two[1] are described here for the first time.

The following is the bibliography on the subject :—

Annandale, N., *Mem. As. Soc. Beng.*, Vol. VI, pp. 150-153 (1917).

Butler, A. L., *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, pp. 387-392 (1903-1904).

Ferguson, H. S., *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, pp. 505-508 (1903-1904).

Flower, S. S., *Proc. Zool. Soc. London*, 1899, pp. 902-903.

Narayan Rao, C. R., *Rec. Ind. Mus.*, Vol. XI, p. 31 (1915).

Narayan Rao, C. R., *Rec. Ind. Mus.*, Vol. XIII, p. 281 (1917).

Smith, M., *Journ. Nat. Hist. Soc. Siam*, Vol. II, pp. 37 and 40 (1916).

Key for the identification of the larvae discussed below :—

Spiracle median, ventral ; mouth without beak or horny teeth	Engystomatidae.
A. Tip of tail ends in flagellum ; lower caudal lobe twice the dorsal at the base	*Microhyla.*
1. Head two-thirds of the body, former squarish. Body transparent, but not the sides . .	*M. ornata.*
2. Head less than half the body ; snout rounded, not squarish. Body not transparent . .	*M. rubra.*
3. Mouth surrounded by a float	*M. achatina.*
4. Body broader than long ; snout abbreviated and truncate	? *M. berdmorei.*
5. Body less regularly oval ; snout shorter ; tint green	*M. pulchra.*
B. Tip of tail not flagellate, but pointed ; caudal fin membranes of equal depth	*Kaloula.*
6. Spiracle a very large tube, nicked posteriorly. Body elongated, elliptical	*K. variegata.*

[1] They belong to the species *K. variegata* and *K. triangularis*. Dr. Annandale tells me that Dr. F. H. Gravely recently collected specimens of *K. variegata* at Chakradharpur in Chota Nagpur

7. Spiracle an inconspicuous transparent tube, not nicked. Body perfectly transparent, with a horseshoe-shaped mark on the head . .	*K. triangularis.*
8. Spiracle almost forms a sheath for the root of the anal tube. Body densely pigmented . .	*K. pulchra.*
9. Spiracle not forming a sheath for the anal tube; length of body more than one and a half times the width	*K. obscura.*[1]
C. Tip of tail obtusely rounded. Tail lobes delicate and at greatest depth individually three-fourths of the muscular portion	*Cacopus.*
10. Spiracle a conical tube opening almost interfemorally. Body and muscular part of tail densely pigmented	*C. systoma.*

Microhyla rubra (Jerd).

LARVA.

1904. Ferguson, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 506.
1915. Narayan Rao, *Rec. Ind. Mus.*, Vol. XI, p. 31.
1917. Narayan Rao, *Rec. Ind. Mus.*, Vol. XIII, p. 282.

I have shown that Mr. Ferguson has mixed up these larvae with those of *M. ornata.*

Microhyla ornata. (Dum and Bibron).

LARVA.

1899. Flower, *Proc. Zool. Soc. London*, p. 902.
1903-1904. Ferguson, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 506.
1903-1904. Butler, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 387.
1917. Narayan Rao, *Rec. Ind. Mus.*, Vol. XIII, p. 282.

Butler remarks " the tadpoles of this and other species of *Microhyla* are very peculiar, being almost perfectly transparent, with the viscera showing through conspicuously." The larvae of *M. ornata* have an opaque reflecting tissue on the sides and the only organ that shows through is the heart. Further down he observes " owing to their extraordinary delicacy I never managed to keep them alive." In my aquarium they thrive quite as well as any of the hardiest of the Ranid larvae.

Microhyla achatina (Boie).

LARVA.

1916. Smith, *Journ. Nat. Hist. Soc. Siam*, Vol. II, p. 37.
1917. Annandale, *Mem. As. Soc. Bengal*, Vol. VI, p. 150.

The modification of the lower lip into a float-like structure resembling that met with in certain species of *Megalophrys* is an interesting fact.

? **Microhyla berdmorei,** Blyth.

LARVA.

1899. Flower, *Proc. Zool. Soc. London*, p. 902.
1917. Annandale, *Mem. As. Soc. Bengal*, Vol. VI, p. 151.

Dr. N. Annandale[2] has shown that the 'transparent larvae' described by Flower are probably those of *M. berdmorei.*

---

[1] I have not had an opportunity to examine the larva and have had to rely on the description of Ferguson (*op. cit.*, p. 506).
[2] *Mem. As. Soc. Bengal*, VI, p. 151 (1917).

Microhyla pulchra (Hallow).

LARVA.

1917. *Microhyla pulchra*, Smith, *Journ. Nat. Hist. Soc. Siam* II, p. 229.

Kaloula obscura, Günth.

LARVA.

1903-04. Ferguson, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 507.

Kaloula pulchra, Gray.

LARVA.

1917. Annandale, *Mem. As. Soc. Bengal*, Vol. VI, p. 152.
1916. Smith, *Journ. Nat. Hist. Soc. Siam*, Vol. II, p. 40.
1903-04. Butler, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 391.

Kaloula variegata (Stoliczka).

This is a very common frog in South India, whose presence after a heavy shower (not less than two inches) is detected by the peculiar cry represented by the syllables "Qhauy, Qhuay, Qhauy." It has been taken in the termites' nest in company with the black scorpion *Palamnaeus*.[1]

LARVA.

Body oval, flat on both surfaces; length to breadth as 3 is to 2, snout rounded, truncate. Nostrils close to the median line, equidistant

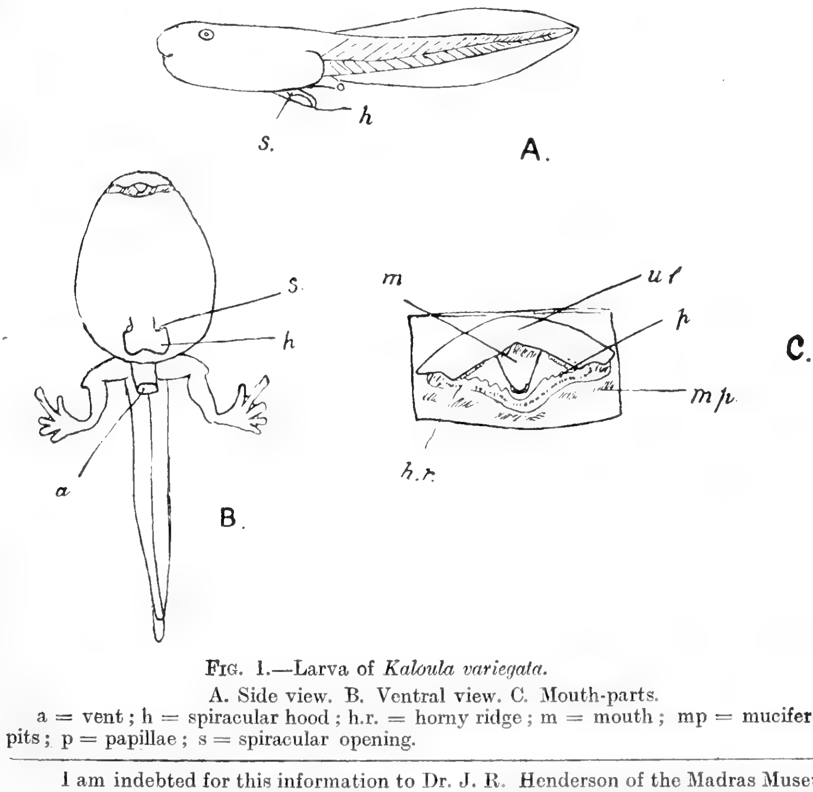


FIG. 1.—Larva of *Kaloula variegata*.
A. Side view. B. Ventral view. C. Mouth-parts.
a = vent; h = spiracular hood; h.r. = horny ridge; m = mouth; mp = muciferous pits; p = papillae; s = spiracular opening.

[1] I am indebted for this information to Dr. J. R. Henderson of the Madras Museum.

between snout and eyes. Internasal space about one-seventh the interorbital. Mouth terminal, both lips contractile and the lower occasionally with a horny rim and microscopic papillae which may extend to the corners of the mouth. A sensory groove connecting nostrils and eye.

Spiracle a large tube, notched behind ; anal tube median. Tip of tail pointed but not flagellate ; both lobes of equal depth, and arched. Greatest depth of tail about one-third the total length.

Body brownish, or gray with minute black spots ; occasionally a blue spot in the groin ; muscular part of tail blotched.

The following are the measurements of a fully grown tadpole :—

	mm.
Total length	45
Length of body	15
Length of tail	30
Maximum width of body	10
Maximum depth of body	8
Maximum depth of tail	10

In the aquarium these tadpoles were noticed to hide themselves under stones and avoid the lighted portion and in ponds they secrete themselves in the deeper recesses, darting to the surface periodically for the purpose of breathing. The metamorphosis is completed in 20 to 30 days in the aquarium, but in nature I have noticed it is over in a fortnight.

Kaloula triangularis (Günther.).

In South India this frog is more common in the hills[1], but is also frequently met with in the plains under a heap of dried leaves or other suitable cover in close proximity to pools of rain-water. Little is known about the habits of the adult.

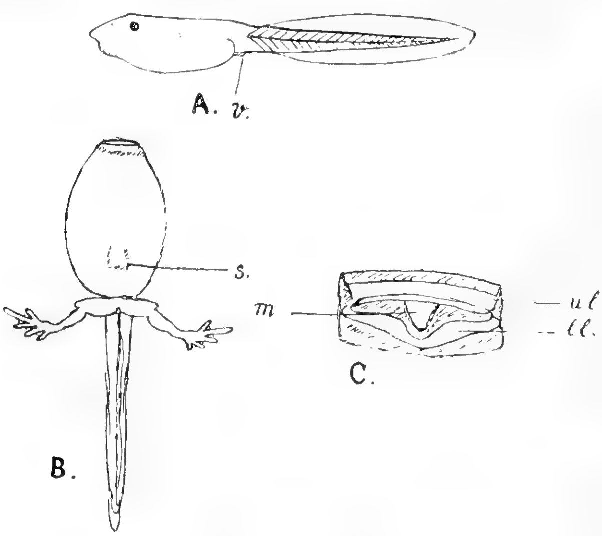


FIG. 2.—Larva of *Kaloula triangularis*.
A. Side view. B. Ventral view, C. Mouth-parts.

[1] Ferguson, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 507.

LARVA.

Body oval, flat; breadth about three-quarters of the length. Snout acumiate, slightly truncated; nostrils equidistant between the snout and eyes. Interorbital space about one-sixth the distance between eyes. Mouth small, without a horny rim or papillae. A naso-orbital sensory groove present.

Spiracle inconspicuous, the free hind edge not notched. Vent inconspicuous, median.

Tail very delicate, tip pointed. The muscular part deeper than the lobes.

Larvae perfectly transparent, with the viscera showing through. They become brown[1] when the front limbs sprout. A dark oval or horseshoe-shaped mark on the back which develops into a triangular blackish spot, occupying nearly the whole length of the back as metamorphosis progresses.

The following are the dimensions of a fully grown tadpole :—

	mm.
Total length	32
Length of body	13
Length of tail	19
Maximum breadth of body	$9\frac{1}{2}$
Maximum depth of body	6
Maximum depth of tail	7

The development is more rapid in this species than in *K. variegata*; it was completed in the aquarium within two weeks; the larvae when introduced measured about 22 mm. If it is assumed that the larvae take about a week to attain this size, then the whole metamorphosis occupies about three weeks.

Cacopus systoma, Schneider.

The adults, which are very common during the monsoon, are great burrowers. They emit a very characteristic sound by which their presence is easily detected. The cry[2] is not unlike the bleating of a goat.

LARVA.

Ferguson, *Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 507.

Addendum.

Dr. Malcolm A. Smith has just published an account of tadpoles from Siam in which he describes the larva of *Glyphoglossus molossus*, Günther, and shows that Flower's "transparent tadpoles" are those of *Microhyla butleri*, Boulenger. See *Journ. Nat. Hist. Soc. Siam* II, p. 261; 1917.

ED.—21-2-1918.

[1] Butler makes a similar remark in connection with the larvae of *K. pulchra* (*Journ. Bombay Nat. Hist. Soc.*, Vol. XV, p. 392).

[2] I am informed by Dr. J. R. Henderson that in captivity, which they stand very well, they feed on termites in large numbers. This habit, coupled with their burrowing tendencies, must account for the small size of the mouth and the hind limbs armed with powerful metatarsal tubercles, a character shared by species like *Rana breviceps* belonging to a different family which have also similar habits.

V. ON TWO ABNORMAL SPECIMENS OF DUCKS IN THE COLLECTION OF THE ZOOLOGICAL SURVEY OF INDIA.

By HERBERT C. ROBINSON, *M.B.O.U.*

Amongst some six hundred duck shot on a swamp near Pathshala in Assam, near the Bhutan Hills, in April, 1917 by Mr. A. Milton were two somewhat uncommon specimens which were presented by him to the Indian Museum.

One of these (25450, Z.S.I.) is a typical male Gadwall *Chaulelasmus streperus* (Linn.) and calls for no special remark.

The other (25451, Z. S. I.), also a male, caused me some considerable trouble in its identification, and until recently I was inclined to consider it as a hybrid between the Common Mallard *Anas boschas*, (Linn.) and the Gadwall *Chaulelasmus streperus* (Linn.).

Comparison of the specimen with other skins and further consultation of the literature has convinced me that I was in error in this identification and that the bird is a hybrid between *Eunetta falcata* (Georgi) and *Chaulelasmus streperus* (Linn.), in which the characters of the first mentioned species are dominant.

The bird is not in full plumage and the highly elongate occipital feathers and strongly decurved and sickle-shaped tertiaries characteristic of the fully adult male Falcated Teal are not strongly in evidence.

The following is a full description of the bird :—

Tail, apparently of sixteen and not fourteen feathers, therein agreeing with *Chaulelasmus* and not *Eunetta.* Upper and lower tail coverts as long as rectrices. Occipital feathers produced, forming a slight "mane."

Anterior lores and an ill-defined frontal patch and a small subocular spot dirty white ; top of the head dull chestnut, sides of the head and occipital mane bronzy green, the feathers faintly tipped with whitish ; chin, throat and an interrupted collar white, narrowly bordered above with blackish ; a broad bronze green collar succeeded by a narrower white one, interrupted behind.

Mantle, hind-neck and breast with broad **V**-shaped vermiculations of white and brownish-black, with a bronzy tint, the white element narrowest. Scapulars and flanks the same, but the vermiculations finer and straighter. A black spot on the outer webs of the outer elongated scapulars. Upper back brownish, faintly vermiculated with white, lower back and upper tail coverts black.

Tail feathers greyish above, whitish beneath, the outer webs with dark edges. Under tail coverts black, the outermost with a large median spot of buff. Belly whitish, finely vermiculated with greyish-black.

Lesser wing coverts dove grey, the innermost vermiculated with whitish ; median coverts grey, the median portion of each feather whitish with the tips of the outer webs broadly chestnut, forming a double wing bar. Outer secondaries black on their outer webs, the inner

secondaries largely white, the inner webs brownish. Elongated tertiaries brownish with white shafts, the outermost with an oily green tinge, edges buff.

Primaries brownish, darker at the tips ; inner aspect of wing whitish, axillaries white.

Bill apparently uniform black, feet dull yellowish-brown (in skin).

Wing 248 mm. ; culmen 45 mm.

The Gadwall is of course a very common duck in India during the winter, though it is not known to breed within the Empire. *Eunetta falcata* on the other hand is very rare indeed within Indian limits, being normally an East Asiatic species. Individuals have, however, been recorded from localities so far apart as Bhamo, Burma and Narra, Sind. Several obtained in the Calcutta bazaar by Mr. F. Finn are in the collection of the Zoological Survey of India and full details of other occurrences are given by E. C. Stewart Baker (*Indian Ducks and their Allies*, p. 143, *et seq.*, London, 1908).

In 1891 Mr. W. L. Sclater (*Proc. Zool. Soc. London*, 1891, p. 313) described a male duck (20505, Z.S.I.) brought in alive to the Indian Museum which he considered to be a hybrid between the Mallard and Gadwall (*Anas boschas* × *Chaulelasmus streperus*).

There is nothing to add to his very full description, but it would appear probable that the bird is a hybrid between *Anas boschas* and *Querquedula crecca* rather than with *Ch. streperus*. The sides of the head are rich brown and the breast has a distinctly spotted appearance, both of which features occur in *Q. crecca*, but cannot be said to be represented in *Ch. streperus*.

The cross is well known and numerous references to it occur in ornithological literature generally under the name of *Anas bimaculata* (Bp.).

The attached plate gives a good idea of the general appearance of the two specimens.

EXPLANATION OF PLATE III.

Abnormal Indian Ducks.

Figs. 1, 1*a*.—Hybrid between *Eunetta falcata* (Georgi) and *Chaulelasmus streperus* (Linn.). 2545, *Z.S.I.*

" 2, 2*a*.—Hybrid between *Anas boschas*, Linn. and *Querquedula crecca* (Linn.). 20505, *Z.S.I.*

1 1a 2 2a

S. C. Mondul, Phot.

ABNORMAL INDIAN DUCKS.

VI. A NEW RACE OF HARE FROM THE PERSIAN FRONTIER OF MESOPOTAMIA.

By H. C. Robinson, *C.M.Z.S.*

Lepus dayanus connori, subsp. nov.

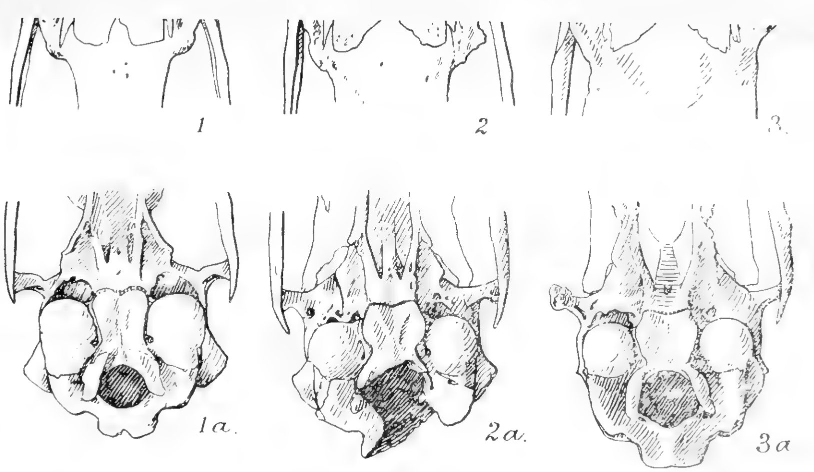
Lepus craspedotis, Thomas (*nec* Blanford), *Proc. Zool. Soc.* 1905 (2), p. 527.

Co-types :—Adult male skin without skull and adult skull unsexed, between Ahwaz and Mohammerah, Karun R., Persia, collected on October 30th, 1917, by Lt.-Col. F. P. Connor, I.M.S. Ind. Mus. Nos. 10278 (skin) ; 10279 (skull).

A form belonging to the section *dayanus*[1] with long broad ears and

ERRATUM.

Figs. 1 and 2 have been accidentally transposed. Fig. 1 represents the skull of *Lepus dayanus craspedotis*; fig. 2 that of *Lepus dayanus dayanus.*



Figs. 1, 1*a*.—Nasal bones and auditory bullae of *Lepus dayanus*, Blanford, from Narra, Sind.
Figs. 2, 2*a*.—Same bones of type of *Lepus dayanus craspedotis*, Blanford, from Pishin, Persian Baluchistan.
Figs. 3, 3*a*.—Same bones of co-type of *Lepus dayanus connori*, nov., from Karun R., S. W. Persia.

[1] *Proc. Zool. Soc.* 1874, p. 633 ; type from Sukkur, Sind.
[2] Blanford, *Ann. Mag. Nat. Hist.* (4) XVI, p. 313 (1875) ; *id.*, *Zool. East. Persia*, II, p 80, pl. viii (1875) ; type from Pishin, S. Baluchistan, examined.

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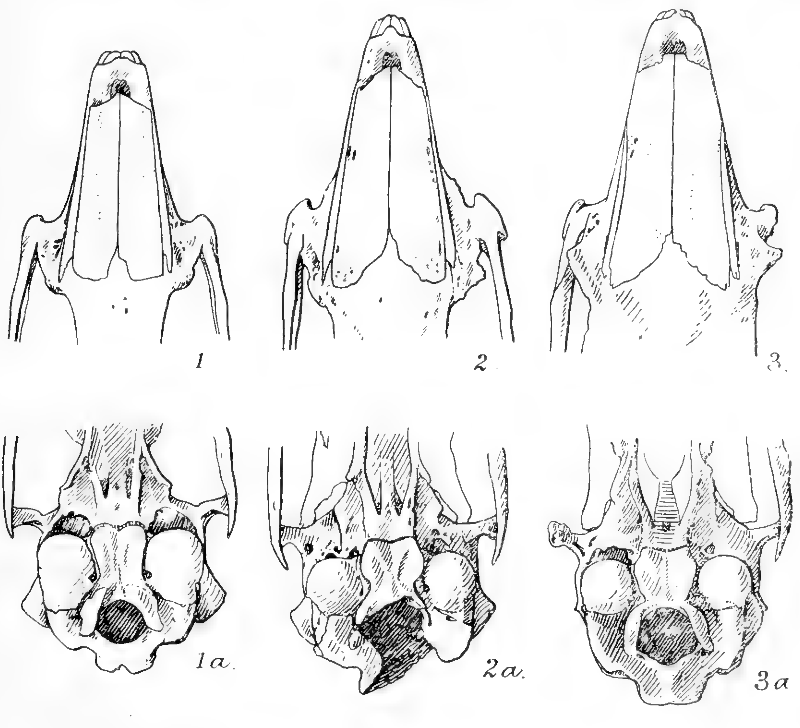
A form belonging to the section *dayanus*[1] with long broad ears and soft pelage. Larger than *L. d. craspedotis* [2] from Baluchistan (type



Figs. 1, 1*a*.—Nasal bones and auditory bullae of *Lepus dayanus*, Blanford, from Narra, Sind.

Figs. 2, 2*a*.—Same bones of type of *Lepus dayanus craspedotis*, Blanford, from Pishin, Persian Baluchistan.

Figs. 3, 3*a*.—Same bones of co-type of *Lepus dayanus connori*, nov., from Karun R., S. W. Persia.

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[1] *Proc. Zool. Soc.* 1874, p. 633 ; type from Sukkur, Sind.

[2] Blanford, *Ann. Mag. Nat. Hist.* (4) XVI, p. 313 (1875) ; *id.*, *Zool. East. Persia*, II, p 80, pl. viii (1875) ; type from Pishin, S. Baluchistan, examined.

examined). Nasals decidedly broader than in *L. d. dayanus*, much produced posteriorly on their outer margins, not truncate as in *L. d. craspedotis.*

Colouration.—Upper surface very pale salmon-buff, the hairs of the back and upper flanks usually with short black tips. Base of the fur pale smoky-grey, lighter on the flanks, succeeded by a broad clearly defined band of black, most pronounced on the back, and then by a salmon-buff subterminal band and a short black tip, often absent. Chest and nape and anterior flanks pale isabelline-buff, the hind limbs more salmon-buff. Chin, inner surface of limbs and under surface of tail pure white. Upper surface of tail deep clear black.

Ears: external half of upper surface clad with fine salmon-buff hair, slightly intermixed with black, the proximal two-thirds of the upper edge fringed with coarse yellowish-buff hairs finely edged with black at the tips; internal half of upper surface almost pure silvery-white with a large patch of black at the tip; this patch edged with buff, the remainder with pure white. Ears internally thinly clad with buffy-white, deeper in tint towards the tips.

Measurements.—Hindfoot (dry) 120 mm.; ear 110 mm.

Skull.—Larger than that of *L. d. craspedotis* or than an equally aged skull of *L. d. dayanus.* Palatal foramina longer and relatively narrower than in either of the allied forms; nasals broad and parallel-sided, much produced posteriorly on their outer margins; cranial region broad. Teeth as in *L. d. dayanus.* Bullae slightly smaller than in *L. d. dayanus*, very much smaller than in *L. d. craspedotis.*

Measurements of the typical skull: greatest length 87 (81·2)[1]; basal length 67 (63·5); greatest length of nasals 39 (31); palatal foramina 23 (20); upper molar series (alveolar) 16 (14·5).

Remarks.—The affinities of this hare, so far as can be judged from descriptions and from the available specimens in the Indian Museum, are almost certainly with the Indian races, of which *L. dayanus* is the best known, rather than with Palaearctic forms. It does not seem in any way connected with forms from Arabia proper and from Muscat, which have been described by Hemprich and Ehrenburg and by Thomas.

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[1] Measurements in parentheses are those of the type of *L. d. craspedotis.*

VII. FURTHER OBSERVATIONS ON *RANA TIGRINA*.

By G. A. Boulenger, *LL.D., D.Sc., F.R.S., and*
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I. REMARKS ON *RANA TIGRINA* AND ITS VARIETIES.

By G. A. Boulenger.

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Needless to say, I have been keenly interested in reading Dr. Annandale's attempt to solve the problem of the species, the races or varieties I should call them, that have been grouped together under the name of *Rana tigrina*.[1]

I cannot help thinking that with a more extensive material, Dr. Annandale would have reached somewhat different conclusions, and the object of these notes is to show on what points his definitions require emendation. I will first discuss the various ' species ' under the names assigned to them by him, and in the same order, and then wind up with my own definition of *R. tigrina* and of the varieties into which it may be divided.

Rana tigrina, Daud.

There can be no doubt as to the application of this name in the restricted sense, and on this point we are in agreement. But I am surprised not to find any allusion to the two forms, strikingly different in their extremes, which are found in India and Ceylon. Dr. Annandale tells us that the inner metatarsal tubercle varies greatly in size and shape, a variation which, according to him, seems to be individual rather than racial, but he appears to me to be mistaken when he adds that this variation is not correlated with other differences and that it occurs at many or all points in the geographical range of the species. The two forms which I think should be distinguished are :—

(1) The typical *R. tigrina*, with smaller and blunter inner metatarsal tubercle ($1\frac{2}{3}$ to 3 times in length of inner toe, $7\frac{1}{2}$ to $12\frac{1}{2}$ times in length of tibia), ' habit rather slender than stout, but moderate rather than extreme in either direction,' and ' the tibia about half as long as head and body.'

(2) The much stouter, often more toad-like *R. crassa*, Jerdon (*fodiens*, Peters *nec* Jerdon, *ceylanica*, Peters) with very large, shovel-shaped inner metatarsal tubercle (1 to $1\frac{1}{2}$ times in length of inner toe, 5 to 7 times in length of tibia), and the tibia $2\frac{1}{7}$ to $2\frac{1}{2}$ times in length of head and body. Further, when the hind limbs are folded at right angles to the body, the heels overlap in the former but do not in the latter ; the tibio-tarsal articulation reaches the eye or between the eye and the nostril in the former, the tympanum or the eye in the latter.

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[1] *Mem. As. Soc. Bengal*, VI, p. 121 (1917).

The differences between these two forms are quite as great as between the typical *R. esculenta* and the var. *lessonae*, and, to judge from the rather scanty material at my disposal, there is not the same overlap.

As regards the distribution, although both forms appear to occur together in some localities (Benares, Malabar, Ceylon), it does not seem to be so generally, and I was assured some years ago by Dr. Henderson that the var. *crassa* is the only one found near Madras town, where its fossorial habits distinguish it so sharply from the true *R. tigrina* as to have raised doubts in his mind as to the propriety of uniting both under the same specific name.

From the following table of measurements it will be seen that the width of the head may considerably exceed its length in both the typical form and the variety. It has been stated that "when the foot is stretched out the margin of the web is slightly convex [1] between the fourth and fifth toes." If *R. crassa* is to be included in *R. tigrina*, this statement requires modification, as Peters in his description of *Hoplobatrachus ceylanicus* ascribes to it a rather deeply emarginate web, as is confirmed by a few of the specimens in the British Museum.

I have another correction to make to Dr. Annandale's definition of *R. tigrina*. The granular nature of the skin in some specimens may extend to the back of the head, as far as the eyes (Benares, Ceylon). Narrow, interrupted, but well defined glandular folds, 6 to 14 in number, are nearly always present on the back, and their number and regularity constitute a fairly good though not absolutely constant character for distinguishing the typical form and the var. *crassa* from the other varieties.

Some specimen of the var. *crassa* (Benares, Malabar) have large black spots on the gular region.

There is often a narrow light vertebral streak or fine line, which may be accompanied by another along the calf, as in the type figured by Daudin ; a broad vertebral band, as in the var. *cancrivora*, I have never seen.

Rana rugulosa, Annand. *nec* Wiegm.

Wiegmann's figures of *R. rugulosa* and *R. vittigera* are excellent and may be relied upon. They demonstrate that these two supposed species, founded on the coloration, are identical, even in a racial sense, and as both show a decidedly pointed snout, the tibia half the length of head and body, and the web between the toes strongly emarginate and not reaching beyond the penultimate phalanx, they answer the definition of *R. cancrivora* and not that of Annandale's *R. rugulosa*.

The name *R. burkilli*, Annand., should therefore be revived for the form, from Burma, Siam, and China, which differs from *R. tigrina*, *s. str.*, in the generally shorter hind limb, the length of the tibia being contained $2\frac{1}{5}$ to $2\frac{1}{2}$ times in that of head and body, the heels not or but slightly overlapping, and the tibio-tarsal articulation reaching the shoulder, the tympanum, or the posterior border of the eye. The fourth

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[1] No doubt a lapsus for 'concave'.

Measurements in millimetres.

	R. tigrina, typica.													var. *crassa*.						
	Lahore.		Sikkim.	Nepal.		Benares.	Madras.	Malabar.		Ceylon.		Penang.(?)*		Benares.	Madras.		Malabar.	Ceylon.		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	♂	♀	♂	♂	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♂	♀	♂	♂	♀	♀
From snout to vent	108	120	108	77	86	142	162	70	65	88	80	158	114	82	90	89	76	76	112	102
Head	38	38	36	26	29	46	51	24	22	30	29	50	38	28	31	29	23	26	36	33
Width of head	40	41	43	26	29	55	62	25	23	32	29	61	40	30	36	32	26	27	40	39
Snout	17	16	16	10	12	20	21	9	9	11	12	21	16	10	12	11	9	10	14	15
Eye	11	11	10	8	9	12	15	8	8	10	9	14	10	8	11	9	9	9	11	11
Interorbital width	4	4	4	3	3	5	6	3	3	3	3	6	5	4	3	3	2·5	2	4	4
Tympanum	8	8	9	6	6	11	11	6	5	6	6	11	8	6	6	6	5	5	8	8
Fore limb	54	57	53	37	40	75	80	37	33	47	41	75	53	39	49	42	36	39	57	60
1st finger	9	11	11	7	8	15	15	7	7	9	7	16	11	8	9	8	7	7	10	11
2nd ,,	7	9	9	6	6	12	12	5	5	7	6	12	9	6·5	7	6	5	5	8	8
3rd ,,	10	14	12	8	9	15	15	7	8	10	8	16	12	9	10	9	7	8	11	11
4th ,,	6	7	9	5	6	12	11	5	5	7	6	11	9	6·5	7	6	5	5	8	8
Hind limb	156	170	167	117	130	202	222	100	97	125	116	225	174	100	139	118	98	106	155	161
Tibia	51	54	58	38	43	71	74	31	30	43	38	75	60	35	42	35	31	32	48	48
Foot	50	52	55	36	42	67	68	32	30	45	38	71	55	38	44	41	32	32	50	50
3rd toe	27	27	27	17	20	33	33	15	15	22	17	34	27	15	23	21	13	16	27	27
4th ,,	39	43	41	28	33	50	49	24	24	37	29	54	43	25	34	31	24	25	38	40
5th ,,	27	28	27	18	23	35	35	17	17	25	19	35	28	17	26	23	16	17	29	29
1st ,,	12	13	13	9	10	17	17	7	7	9	8	17	14	7	9	7	6	7	9	10
Inner metat. tubercle	5	6	7	3	4·5	9	9	4	4	5	4	9	6	7	6	6	6	5	7	7

* This locality is doubtful, as in the case of other specimens, probably from India, described by Cantor as found in the Malay Peninsula.

toe is usually, but not constantly, shorter ; sometimes the third toe reaches the distal subarticular tubercle of the fourth, sometimes it does not ; there is no constant difference in the degree or emargination of the web, the large specimen from Toungoo, of which measurements are given in the following table, having the web as full and as feebly notched as in any Indian specimen I have seen. The inner metatarsal tubercle is blunt and its length is $2\frac{1}{2}$ to 4 times in that of the inner toe and $8\frac{2}{3}$ to 14 times in that of the tibia.

Although usually more rounded than in the typical form, the shape of the snout cannot be used for the distinction of this variety since it is more pointed and prominent in some specimens from China (Shanghai) than in others from India (Madras).

The folds on the back, if present, are short and in many cases they are more correctly described as elongate warts.

The absence of any trace of a light streak above the upper lip, which is marked with vertical dark bars, one or two of which may extend to the eye, distinguishes this form, but the presence of black spots or marblings on the lower parts is not constant ; a specimen from Pegu is without any spots on the throat and belly, and others from Thayetmyo, Ayuthei, and Shanghai have the markings reduced to a streak in the middle of the throat. A light vertebral streak or band is absent in all the specimens examined by me.

The size often exceeds 110 millimetres from snout to vent (Toungoo, Siam, Shanghai).

Measurements in millimetres.

	var. *burkilli.*														
	Toungoo.	Thayetmyo.	Mandalay.	Pegu.	Takhana, Siam.	Siam.		Ningpo.		Shanghai.		Formosa.			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	♀	♀	♀	♂	♂	♀	♀	♂	♀	♂	♀	♀	♀	♀	♀
From snout to vent .	142	60	57	127	93	130	133	85	95	90	117	92	91	90	89
Head . . .	47	20	19	39	30	41	44	28	32	27	37	28	28	29	29
Width of head . .	53	21	21	44	32	45	53	32	34	30	43	32	31	33	31
Snout . . .	20	9	8	16	12	16	16	12	12	12	15	11	12	12	11
Eye	13	7	6	11	10	12	12	8	8	8	10	9	9	9	9
Interorbtal width .	5	2·5	2·5	4	3	5	5	4	4	4	5	3	3	3	3
Tympanum . .	10	4	4	9	6	8	9	7	6	8	8	7	7	7	7
Fore limb . .	73	29	27	65	48	63	70	45	49	50	58	48	45	46	46
1st finger . . .	15	6	6	13	9	12	13	10	9	11	12	9	9	9	10
2nd ,, . . .	13	5	5	10	8	10	10	8	8	9	10	7	7	8	8
3rd ,, . . .	15	7	6	14	10	14	14	10	10	11	13	10	10	10	10
4th ,, . . .	12	4	4	10	7	9	10	7	8	9	9	7	7	7	7
Hind limb . .	180	80	72	159	128	178	192	120	140	138	160	116	123	125	125
Tibia . . .	58	26	24	52	40	57	62	38	39	40	47	38	37	39	38
Foot . . .	62	26	24	54	44	59	64	42	43	47	54	42	43	42	42
3rd toe . . .	31	15	13	27	22	28	35	23	25	26	28	21	22	23	23
4th ,, . . .	60	21	18	42	35	46	54	34	35	39	43	32	34	34	34
5th ,, . . .	35	16	13	30	26	33	38	24	26	28	30	23	24	24	25
1st ,, . . .	17	7	6	14	11	15	16	12	12	13	14	11	11	10	11
Inner metat. tubercle	6	3	2	6	3	4	6	3	3	4	5	4	3	4	4

This form is hardly to be distinguished from the African *R. occipitalis,* Gthr., the range of which extends from the Egyptian Soudan and Uganda to the Senegal and other parts of West Africa as far south as Angola. I am not sure I could always tell a Burmese frog from an African, and the tadpoles are identical. Although I have examined over forty specimens of *R. occipitalis,* I have never seen one with a light vertebral streak. It reaches a length of 130 millimetre from snout to vent.

Rana cancrivora, Gravenh.

I have a large material from the Indo-Malay Archipelago which shows that although the toes vary considerably in length, the web between them is always strongly emarginate ; in some specimens even the two last phalanges of the fourth toe are free from the web, and such may be described as having the toes three-fourths webbed. The length of the tibia is $1\frac{3}{4}$ to $2\frac{1}{4}$ times in the length of head and body, the heels strongly overlap, and the tibio-tarsal articulation reaches the eye or between the eye and the nostril ; the longer hind limb thus distinguishes the var. *cancrivora* from the var. *burkilli.* The inner metatarsal tubercle is blunt and its length is contained $2\frac{1}{2}$ to 3 times in that of the inner toe, $8\frac{1}{2}$ to 12 times in that of the tibia.

The shape of the head varies greatly ; it is often quite as long as broad, and it may even be slightly longer (Padas, N. Borneo) ; the snout may be broadly rounded or as pointed as in any specimen of *R. tigrina typica* ; when the snout is pointed, the nostril is as a rule equidistant from the eye and the tip of the snout.

The distance between the eye and the tympanum measures $\frac{1}{2}$ to $\frac{3}{4}$ the diameter of the latter ($\frac{2}{5}$ to $\frac{2}{3}$ in the typical form).

The vomerine teeth vary considerably and often differ from those of the typical form in being disposed in rather short oblique series, well separated from the anterior borders of the choanae ; but some specimens (Borneo, Java, Celebes) have longer and stronger series, which agree entirely with the usual description.

The longitudinal dermal folds, in the strict sense, are often absent on the body ; if present, they are reduced to 2 or 3 pairs.

The coloration is much as in the var. *burkilli,* but there may be, rather exceptionally, a light streak along the side of the body, as in the typical form (specimens from the Phillippines and Celebes) ; a light vertebral line or broad band is sometimes also present, but it is very rarely accompanied by a light line along the calf (specimens from the Philippines). This is a small form, not exceeding the length of 90 millimetres from snout to vent assigned to it by Dr. Annandale.

I will now give a definition of *Rana tigrina* and of the forms into which it may be divided.

Rana tigrina, Daud.

Vomerine teeth in strong or very strong oblique, straight or slightly curved series narrowly separated from each other, originating close to or at a short distance from the anterior border of the choanae and usually extending beyond the level of their posterior borders. Head as long as

Measurements in millimetres.

var. *cancrivora.*

	Jambu, Jalor.	Kedah.	Deli, Sumatra.	Java.				Sumbawa.	Sumba.			Ombay.		Timor.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	♂	♀	♂	♂	♂	♀	♀	♀	♂	♀	♀	♂	♂	♀
From snout to vent.	49	82	60	88	77	88	75	65	56	67	59	57	57	73
Head . .	16	27	21	28	26	29	26	22	20	22	21	20	21	23
Width of head	18	30	21	32	27	30	27	22	20	22	22	21	22	27
Snout . .	7	11	8	11	11	12	11	9	7	9	8	7	7	9
Eye . .	6	8	7·5	8	8	8	8	8	7	8	7	7	7	8
Interorbital width.	2	3·5	3	4	3	3	3	3	2·5	3	2·5	2	2	3
Tympanum .	3·5	6	4	6	6	6	6	4	4	4	4	4	4	4·5
Fore limb	30	46	36	47	40	47	42	32	31	35	32	33	34	39
1st finger .	6	9	7	9	10	11	10	7	6	7	7	7	7	8
2nd ,, .	5	8	6	8	7	8	8	6	5	6	6	6	5	7
3rd ,, .	7	10	8	10	10	11	10	7	6·5	7	7	7	7	9
4th ,, .	4	6	5·5	7	6	8	7	5	5	6	6	5	5	6
Hind limb .	74	119	86	131	115	132	112	93	82	102	87	95	92	108
Tibia . .	23	38	27	42	37	42	36	29	26	33	29	30	30	35
Foot . .	25	41	32	45	40	45	39	29	26	35	30	31	30	36
3rd toe .	14	20	17	22	19	23	20	14	13	17	14	15	15	18
4th ,, . .	19	33	25	37	32	37	31	23	19	27	24	24	25	26
5th ,, . .	14	23	18	27	22	27	21	16	14	19	17	16	17	18
1st ,, . .	6	10	8	11	9	11	10	7	6	8	7	7	7	9
Inner metat. tubercle.	2	4	3	4	4	4	4	3	2·5	3	2·5	3	2·5	3

	Borneo.				Padas, N. Borneo.				Philippines.		Surigao, Philippines.		Laguna del Bay, Philippines.	Manado, Celebes.	Kema, Celebes.
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
	♂	♂	♂	♀	♂	♂	♀	♀	♀	♀	♀	♀	♀	♂	♂
From snout to vent.	86	81	78	86	59	54	57	57	66	61	75	72	72	82	68
Head . .	29	27	27	29	20	19	18	19	22	21	26	24	22	24	25
Width of head	31	27	27	29	19	21	18	20	23	21	27	26	25	26	25
Snout . .	11	11	11	12	8	7	8	8	9	8	10	10	9	10	10
Eye . .	8	8	8	8	7	6	7	7	8	7	8	9	8	8	8
Interorbital width.	3	3	3	3	2·5	2·5	2·5	2·5	2·5	2·5	3	3	2·5	3	3
Tympanum .	6	6	7	6	4	4	4	4·5	5	5	6	6	5	6	5
Fore limb	47	45	43	47	36	34	34	34	37	32	42	39	36	45	41
1st finger .	9	10	10	10	7	6	7	7	9	8	9	9	8	10	9
2nd ,, .	6	8	7	7	5	5	5	5	7	7	7	8	7	8	7
3rd ,, .	9	10	10	10	7	7	8	8	9	8	9	9	9	11	9
4th ,, .	6	8	7	7	5	5	5	5	6	6	7	6	6	8	7
Hind limb .	127	120	121	140	90	87	88	93	111	95	107	103	105	122	110
Tibia . .	41	39	38	43	28	27	28	29	36	31	34	32	35	37	35
Foot . .	43	43	43	47	30	29	30	33	36	31	36	35	35	41	38
3rd toe .	21	20	20	23	15	14	15	18	19	17	18	17	17	20	20
4th ,, . .	36	36	35	38	22	22	23	25	29	26	30	29	29	33	33
5th ,, . .	24	24	25	25	16	16	16	18	21	18	23	22	20	25	23
1st ,, . .	9	11	10	12	7	7	7	8	9	7	9	9	8	10	10
Inner metat. tubercle.	4	4	4	4	2·5	3	3	3	3·5	3	4	3·5	3	4	4

broad or broader than long, rarely slightly longer than broad; snout rounded or pointed, projecting more or less beyond the mouth, longer than the eye in the adult; canthus rostralis obtuse; loreal region very oblique, more or less concave; nostril equidistant from the eye and the tip of the snout or nearer the latter; interorbital space much narrower than the upper eyelid; tympanum very distinct, $\frac{1}{2}$ to once the diameter of the eye, its distance from the latter $\frac{2}{5}$ to $\frac{3}{4}$ its diameter. Fingers obtusely pointed, first longer than second; subarticular tubercles rather small and feebly prominent. Hind limb variable in length, but tibio-tarsal articulation never reaching the tip of the snout; heels meeting or overlapping when the limbs are folded at right angles to the body; tibia $1\frac{3}{4}$ to $2\frac{1}{2}$ times in length from snout to vent, as long as, or shorter than the foot, usually shorter than the fore limb. Toes obtuse or somewhat swollen at the end, at least $\frac{3}{4}$ webbed, often webbed to the tips; subarticular tubercles rather small; a more or less developed dermal fold on the outer side of the fifth toe and usually a feeble one on the inner side of the first and of the tarsus, interrupted by the inner metatarsal tubercle, which may be small and blunt or large and sharp-edged; no outer metatarsal tubercle. Upper parts rarely nearly smooth, usually with large, more or less prominent warts forming longitudinal series on the back, or with more or less regular longitudinal glandular folds; usually a strong fold across the head, behind the eyes continued as a curved glandular fold from the eye to above the shoulder; lower parts smooth.

Male with a white or grey external vocal sac on each side of the throat, forming longitudinal folds; fore limb moderately thickened; a strong pad on the inner side of the first finger, covered, during the breeding season, with a greyish-brown velvet-like horny layer.

Nasal bones large, in contact with each other and with the fronto-parietals; ethmoid hidden or only a small portion uncovered; fronto-parietals narrow, feebly grooved along the median line, sometimes fused; zygomatic process of squamosal long. Coracoids more or less distinctly overlapping with their proximal extremities; clavicles strong and horizontal; omosternum and sternum with a moderately long bony style, the former forked at the base. Terminal phalanges obtusely pointed.

Tadpole with the tail attenuate to a fine point, about twice as long as the body. Circular lip entirely bordered with papillae; back entirely black, the upper mandible with a strong median cusp, the lower with two; horny teeth in 3 or 4 upper and 4 or 5 lower series, the outer upper long and uninterrupted, the outer lower short and uninterrupted, the outer but one lower long and uninterrupted.

A. Regular glandular folds, 6 to 14 in number, usually present on the back; toes webbed to the tips.
- Tibio-tarsal articulation reaching the eye or between the eye and the nostril; heels overlapping; tibia $1\frac{9}{10}$ to $2\frac{1}{5}$ times in length of head and body; metatarsal tubercle $\frac{1}{3}$ to $\frac{3}{5}$ length of inner toe . *Forma typica*
- Tibio-tarsal articulation reaching the tympanum or the eye; heels not overlapping; tibia $2\frac{1}{7}$ to $2\frac{1}{2}$ times in length of head and body; metatarsal tubercle $\frac{2}{3}$ to once length of inner toe . . . . var. *crassa*, Jerd.

B. Glandular folds much broken up or absent; if long, fewer in number; inner metatarsal tubercle $\frac{1}{4}$ to $\frac{2}{5}$ length of inner toe.

a. Toes webbed to the tips or at least to the base of the last phalanx of the fourth; tibia $2\frac{1}{5}$ to $2\frac{1}{2}$ times in length of head and body; heels not or but slightly overlapping.

Tibio-tarsal articulation reaching the eye or between the eye and the nostril . . . . . var. *occipitalis*, Gthr.

Tibio-tarsal articulation reaching the shoulder, the tympanum, or the posterior border of the eye . var. *burkilli*, Annand.

b. Toes incompletely webbed, one or two phalanges of fourth free; tibia $1\frac{3}{4}$ to $2\frac{1}{4}$ times in length of head and body; heels strongly overlapping: tibio-tarsal articulation reaching the eye or between the eye and the nostril . . . . var. *cancrivora*, Gravh.

In uniting these different forms under one species, I am simply adhering to the standard adopted in the case of *R. esculenta*, in which we find the same amount of variation in the shape of the head, in the proportions of the hind limb, in the development of the inner metatarsal tubercle and, nearly though not quite, in the extent of the web between the toes; and as I have not the slightest doubt as to the justification of the course followed in dealing with that highly variable and widely distributed species, of which I have carefully studied a very large material, I feel satisfied that the conclusion adopted in the analogous case of *R. tigrina* serves best the purposes of exact systematics. It has always been my firm conviction that the multiplication of specific names on differences which break down when put to the test of a large material is not conducive to an advance in our knowledge, whilst the recognition of forms to which subordinate rank is assigned fulfils all requirements and leads to a truer appreciation of the state of things in Nature.

It is, however, with diffidence and provisionally that I include *R. cancrivora* among the varieties of *R. tigrina.*

I have not seen examples of van Kampen's *R. angustopalmata*, from Macassar, but if its tadpole is practically identical with that of *R. limnocharis*, as he states, may it not be a distinct species? As to the tadpoles described from Java, is a confusion with *R. limnocharis* absolutely out of question? Dr. van Kampen himself, when alluding to Flower's identification of Siamese tadpoles, regarded it as almost incredible that the Malay frog, so difficult to distinguish from the Burmo-Siamese, should differ to that extent in the larval condition. I therefore believe the question of the specific rank of *R. cancrivora* should remain open until Dr. van Kampen adduces further proof of the correctness of his identification of the Javan tadpoles.

I hope I may be pardoned for raising these doubts, in view of the fact that, even in so geographically remote a form as *R. occipitalis*, the very striking buccal characters of the tadpole of *R. tigrina* have remained unchanged.

If, however, it should be established beyond doubt that *R. cancrivora* passes through a larval stage so different from that of *R. tigrina*, I would then unhesitatingly endorse Dr. Annandale's conclusion as to the specific distinction.

II. FURTHER NOTES ON *RANA TIGRINA* AND ALLIED FORMS.

By N. Annandale.

Rana tigrina is one of the commonest Indian frogs and is used for dissection in all the North Indian colleges in which practical zoology is taught. Its identity is therefore a matter of more than usual interest to naturalists in India. I have recently expressed the opinion [1] that the species should be divided into three forms, which I have treated as specifically distinct. I have, however, pointed out that one of these forms (*R. cancrivora*, Gravenhorst) stands on a somewhat different footing from the other two (*op. cit.*, p. 136). Dr. G. A. Boulenger has replied to my observations in a paper printed immediately before this one. He holds that not three but five forms must be recognized. In this I am in agreement with him, but he differs from me in regarding all these forms as varieties or races of a single species. I am glad that my remarks have at any rate called his vast experience to bear on the problem, but there are still certain points both general and particular in which I find myself unable to accept his decision.

In the first place he expresses the opinion that if I had had a larger collection before me I would probably have come to conclusions other than those I arrived at with only the specimens in the Indian Museum to examine. This may be true, but only with qualifications. If I had had both this and the British Museum collections before me at the same time I would certainly have recognized the Madras form as distinct, but I do not think from what he says that I would have had reason to alter my views as to either the geographical or, with the exception stated, the taxonomic limits of the three forms that I recognized. The correct names (specific or racial) of the forms discussed (as distinct from their identity) depend, in the absence of adequate original descriptions, not on the examination of a large number of specimens from different localities, but rather on geographical considerations and on the interpretation of published figures.

The question whether the forms under discussion should be called species or races depends on one's concept of these terms—a subject on which a difference of opinion is perhaps legitimate. I have called certain forms allied to *R. limnocharis* "races or sub-species," though Dr. Boulenger recognizes them as distinct species. My reason for this has been that the forms which I regard as mere races are to some extent isolated geographically and that a considerable proportion of the individuals representing each differ from the *forma typica* in relatively unimportant characters such as size and colour. On the other hand I call forms included under the specific name *Rana tigrina* by Dr. Boulenger "species," because they are not isolated geographically but occur over large areas together, and because I do not think that individuals intermediate in character ordinarily occur.

The following notes on the four forms that occur in the Indian Empire and the Malay Peninsula are based mainly on the examination of living

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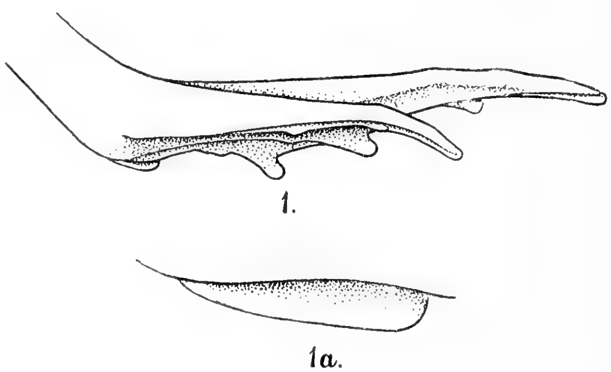
[1] *Mem. As. Soc. Bengal*, Vol. VI, part II, 1917.

or freshly preserved specimens examined since I have had the advantage of reading Dr. Boulenger's notes.

Rana tigrina, Daudin.

I have little to add to Dr. Boulenger's notes on this frog except in reference to its geographical distribution. I will, however, discuss the form and structure of its inner metatarsal tubercle in dealing with *Rana crassa.*



FIGS. 1, 1*a*.—Right foot of *Rana tigrina* from Calcutta, with metatarsal tubercle enlarged.

Geographical distribution.—I have made a careful examination of the specimens in the Indian Museum referred to in my original paper (*op. cit.*, pp. 125-126) and find no reason to change my opinion as to the great majority of them. The form certainly occurs not only in Northern India, but also at many places in the south of Peninsular India, as well as in Assam, Burma and Yunnan. Its range thus overlaps that of both *R. crassa* and *R. rugulosa.* Apparently it differs in habits from both these forms, being feebly or not at all possessed of powers of burrowing.

Rana rugulosa, Wiegmann.

The name of this species depends entirely on the interpretation of Wiegmann's figure. [1] I have great hesitation in differing from Dr. Boulenger on a point of interpretation, but cannot agree with him that the snout is represented as being pointed; indeed, Wiegmann says "Schnautze stumpf." Nor can I agree that the feet are meant to be webbed in exactly the same way as in the figure of *Rana vittigera* on the same plate. I have no doubt, therefore, that the types of my *Rana burkilli,* which are in very good condition, and also the series of specimens sent to me by Dr. Malcolm Smith from Siam are specifically identical with the specimen that Wiegmann selected to be figured as typical of his *R. rugulosa.*

[1] *Nov. Ac. Ac. Leop.*, XVII, pl. xxi, fig. 2 (1835).

Dr. Smith [1] has recently sent me three tadpoles, which agree well with Flower's figures.

Geographical distribution.—The species appears to be widely distributed in Burma, Siam and China. In Burma it is found commonly with *Rana tigrina, s. s.* and in Southern Siam with *R. cancrivora*, but apparently it does not penetrate far south into the Malay Peninsula.

According to Burkill [2] both this species and *R. tigrina* are eaten by the Burmese. At Prome the former is said to be distinguished from *R. tigrina* (which the Burmese call Hpa Zang under the name Hpa Boung-she. It is stated by them to differ also in habits, in which apparently it resembles *R. crassa*, although the inner metatarsal tubercle is usually small and resembles that of *R. tigrina* in structure. The tubercle is perhaps, however, somewhat more prominent than in the latter.

Rana crassa, Jerdon.

1854. *Rana crassa*, Jerdon, *Journ. As. Soc., Bengal*, XXII, p. 531.

Jerdon's original description of this species is very short and is not accompanied by a figure. The frog is, however, in my opinion quite distinct. The reason why I did not recognize it was that the only specimens I had examined were very old and all more or less distorted. Dr. J. R. Henderson has been kind enough to send me five living frogs from Madras. A comparison of these specimens with those already preserved in the Indian Museum has convinced me that there is much less variation within the limits of *Rana tigrina, s.s.* than I formerly thought to be the case.[3]

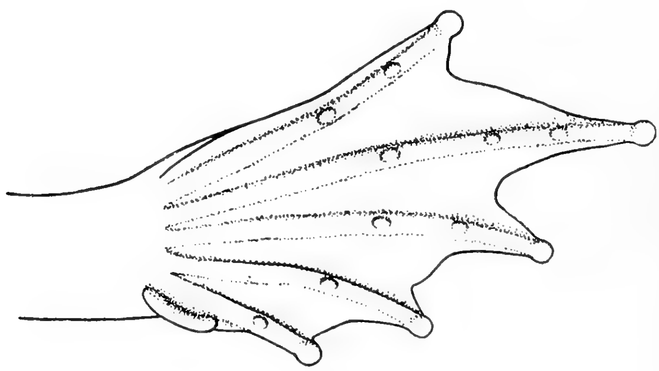
The most important difference to be recognized in preserved material lies not so much in the size as in the structure of the inner metatarsal tubercle, and this character is very liable to be obscured. In *R. crassa* the tubercle is usually larger than in *R. tigrina, s. s.*, but my original statement that its size is not correlated with other characters is literally correct so far as either form is concerned. In *R. tigrina*, however, it is a simple broad longitudinal ridge rounded on the inner surface and situated at some little distance behind the base of the fifth toe ; whereas in *R. crassa* it is much more prominent (at any rate in the living frog) and is distinctly concave on the inner surface, with a strong blunt carina running along its lower margin. It is also situated further forward

[1] Dr. Smith has just published further figures of the tadpole. See *Jorn. Nat. Hist. Soc., Siam* II, p. 263, pl. iv, figs. 2, 2*a*.

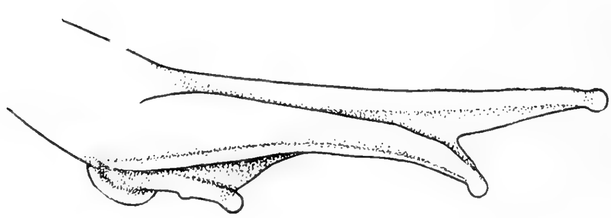
[2] *Agricult. Ledg.*, No. 2, pp. 13 and 15 (1911).

[3] Since Dr. Boulenger saw this note Dr. Henderson has sent me twelve further specimens of *R. crassa* well preserved in spirit. So far as the immediate neighbourhood of Madras is concerned they bear out the views expressed above. There is, however, one very important fact connected with them, *viz.*, that Dr. Henderson captured at the same time a single specimen to which he drew my attention and which I cannot distinguish from *R. rugulosa* from Burma. The occurrence of a single individual of this form, so far from its proper home, suggests the question, may not *R. rugulosa* (or *R. tigrina* var. *burkilli* as Dr. Boulenger calls it) have arisen as a mutation of *R. crassa*? The fact that specimens of *R. crassa* itself have been found sporadically in Northern India, would further suggest that it also may have arisen as a mutation, from the typical *R. tigrina*. Further evidence is, however, necessary before attempting to answer this question. In any case it has no bearing on the taxonomic position of *R. cancrivora*.

on the foot, almost parallel to the basal part of the toe, and has a much stiffer consistency, being strongly cornified in old frogs. When specimens are preserved in spirit, however, the tubercle is apt, owing to the shrinkage of the soft tissues of the foot, to collapse in such a way that its concave surface lies flat on the sole and is thus entirely concealed. This has occurred in all the old specimens that I have examined.



2.



2 a.

2 b.

FIGS. 2, 2*a*, 2*b*.—Right foot of *Rana crassa* from Madras (× 2), with metatarsal tubercle further enlarged.

The colour of living specimens from Madras is similar to that of *R. tigrina*, but much duller, a dull brown being substituted for the greens and yellows, and with the exception that the throat is spotted with black. In general appearance the frog seems to be very like *R. rugulosa*, and Indian specimens that I referred to as being intermediate between that species and *R. tigrina* actually belong to *R. crassa*.

I have been able to examine only two tadpoles that can be assigned to this species. In one of them the hind legs are fairly well-developed, while in the other the toes are already differentiated. So far as it is

possible to make a definite statement on the basis of this material, they differ from those of the true *R. tigrina* in the following particulars :—

They are larger and of stouter build, with the abdomen more convex ; the dorsal surface is more densely pigmented and there is a pale band extending backwards in an oblique direction from the nostril to a pale space surrounding the eye. They very closely resemble those of *R. rugulosa*, except that the dorsal membrane of the tail is not so elevated and that the coloration of the dorsal and lateral surfaces of the head and body is less uniformly mottled.

Geographical distribution.—The following specimens in the collection of the Indian Museum must be transferred to this species :—

9025. Agra, United Provinces. Agra Mus. (Ex.).
12572. Chandbally, Orissa. C. H. Dreyer.
9074-5 : 9071. Ceylon. Dr. Kelaart.
9017 : 9057 : 9060. Colombo, Ceylon. Dr. J. Anderson.

Combining my records with those of Dr. Boulenger, we find, therefore, that *R. crassa* is by no means confined to South India, in some part of which it probably occurs together with *R. tigrina*, *s.s.*, and Ceylon, where it may occur alone. It is known from Agra and Benares in the United Provinces, from Orissa, from the town of Madras and from several other localities on both coasts of the Indian Peninsula, as well as from several localities in Ceylon.

The behaviour of the living specimens sent to me from Madras differed totally from that of individuals of *Rana tigrina, s. s.* The former when placed in a vivarium the bottom of which was covered with sand, burrowed immediately and concealed themselves below the surface. This I have never known *R. tigrina* to do. Moreover, they did not possess anything like the same power of leaping.

Rana cancrivora, Gravenhorst.

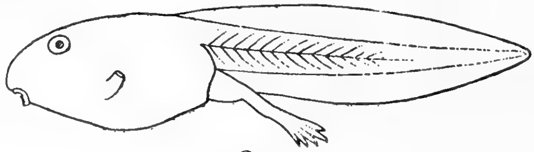
Dr. Boulenger's notes rather lead me to think that there may be in the Malay Archipelago several races or species closely allied to this form. Dr. Van Kampen's var. *angustopalmata*[1] may perhaps be distinct after all. My chief reason for including it in the synonymy of *R. cancrivora* was a letter from him in which he wrote as follows :—" My *angustopalmata* has a still somewhat shorter web than this *R. cancrivora*, but this difference does not occur in all specimens from Celebes, and as it is very difficult to describe it is perhaps better to drop the name."

It is important, therefore, that I should make it quite clear that my description was based almost entirely on specimens from Siam, one of which Dr. van Kampen had kindly compared with specimens from Java, the type locality of the species. I had also examined a series of old and sodden specimens from North Borneo, but had paid, in accordance with my usual rule, comparatively little attention to them.

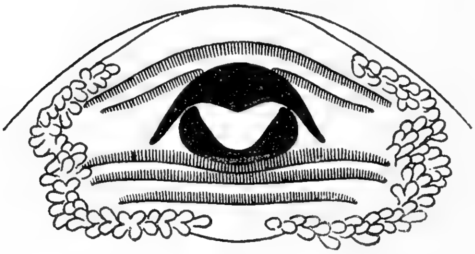
Doubt has been cast by Dr. Boulenger on the identification of the tadpole of this frog by Dr. van Kampen. *R. cancrivora* is a very common frog in the plains of Java, where *R. limnocharis* is, according to

[1] In Weber's *Zool. Ergebn. Neid. Ost.-Ind.*, IV, p. 388, pl. xvi, fig. 3c.

Barbour,[1] scarce. Dr. van Kampen paid great attention to the Batrachian larvae of the island when resident there for some years and it seems to me improbable that a tadpole so peculiar as that of the *R. tigrina* type, had it been at all common, would have escaped his notice. Moreover, Dr. Malcolm Smith of Bangkok has sent me tadpoles from Siam that



3.



3a.

FIGS. 3, 3*a*.—Tadpole of *R. cancrivora* from Siam (×2), with mouth-disk further enlarged.

conform, with minor differences, to the *R. limnocharis* type, and which he identifies as those of *R. cancrivora*. About them he writes :—

> "The specimens that I sent you last week are I think without doubt *cancrivora*. My men brought in a large number from the mouth of the Chumpon River (P. Siam), where the frog was common, and with young ones just leaving the water from which I have made the diagnosis. They differ from van Kampen's description only in the 3rd or lowest tooth row of the lower lip. In *cancrivora* this is nearly or quite as long as the row above, whilst in *limnocharis* it is only half the length. Koh Lah specimens confirm this, but I will get some living tadpoles and confirm the frog."[2]

The chief differences between these tadpoles and the larvae of *R. limnocharis* are that (1) the dorsal membrane of the tail is much less sinuate in outline; (2) the tail is shorter and less pointed, and (3) the

[1] *Memoirs of the Museum of Comparative Zoology at Harvard College*, Vol. XLIV, No. 1, p. 65.

[2] Dr. Smith has recently (October 10th, 1917) sent me the following additional note :—" There is other evidence, however, by which I am quite sure that *R. rugulosa* and *R. cancrivora* are distinct. Their breeding calls are entirely different. That of the former is a deep " wrnk, wrnk, wrnk (WRNK) " of the latter a loud bleat, something like the noise produced by a goat. I have kept them both and am sure on this point." I understand that Dr. Boulenger now accepts *R. cancrivora* as distinct. Dr. Smith (*Journ. Nat. Hist. Soc., Siam* II, 264) has just published a note on the tadpole.

dorsal coloration is darker and more uniform. The mouth-disk and its armature are closely similar except that the lowest tooth-row on the lower lip is broader and the teeth larger, and that the fringe of papillae is interrupted on the middle below.

Geographical distribution.—The only point precisely ascertained as to the general range of this species is that it occurs in South Siam, including the provinces of Singgora and Patani in the Malay Peninsula, as well as in Java. It is apparently synonymous with *R. schlueteri*, Werner, from North Borneo, but there is a possibility that the var. *angustopalmata* of van Kampen from Celebes may be distinct, if it is not synonymous with *R. vittigera*, Wiegmann, from the Philippines.

III. POST-SCRIPTUM.

By G. A. BOULENGER.

Dr. Annandale having most courteously communicated to me his reply to the suggestions contained in the first paper, I will add a few words rather than make any alteration to my original draft.

As I say in the last paragraph, my opinion on the rank to be assigned to *R. cancrivora* stands or falls on the question of the tadpole, and as Dr. Annandale appears to have proved his case, I have no further reason to disagree with him, except from the theoretical point of view.

The old conception of the frog in its development climbing up its own genealogical tree must be abandoned. As I pointed out twenty years ago,[1] " larval forms such as the tadpoles are outside the cycle of recapitulation, the ontogeny being broken by the intercalation of the larval phasis. The horny beak, the circular lip with its horny armature, the spiraculum, the enclosure of the fore limbs in diverticula of the branchial chambers, and such special adaptations as the ventral disc or sucker of certain mountain forms, clearly point to tadpoles having had a developmental history of their own. We need, therefore, not be surprised at occasionally finding, within the same genus, very different types of tadpoles, or even a total suppression of the larval stages, as is actually the case in the large and widely distributed genus *Rana*." That adaptational gyrinal polymorphism occurs has been pointed out by Camerano,[2] and I have myself drawn attention to a very remarkable dimorphism, apparently non-adaptive, in *Pelodytes punctatus*.[3]

Our progress in the knowledge of the metamorphoses of Batrachians has most decidedly invalidated the prediction of my late chief Dr. Günther who, in his Preface to my Catalogue of 1882, expressed the opinion that probably the next step in perfecting the system of classification would be marked by a consideration of the larval stages.

I conclude, from the close agreement of *R. cancrivora* with the other forms grouped under *R. tigrina*, that the differentiation of the tadpole has arisen independently from that of the adult, the cuspidate beak and other buccal features of the *R. tigrina* tadpole being, of course, as

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[1] *Tailless Batrachians of Europe*, p. 110.
[2] *Atti. Acc. Torin.*, XXVI, 1890, p. 72.
[3] *Proc. Zool. Soc.*, 1891, p. 617, pl. xlvii, figs. 1, 2.

Dr. Annandale admits, deviations from the more normal pattern preserved in *R. cancrivora* ; and therefore I do not think that the case in question points to forms originally distinct having converged to resemble each other in the adult condition. My opinion is supported by various examples, drawn from other types of animals, which Giard (1891-1892) has grouped together under the term poecilogony, the list of which is constantly being increased.

I am glad my remarks have led Dr. Annandale to procure further material of the Bull-frog which occurs commonly in India and Ceylon ; I only regret he has not had more before expressing a decided opinion on the two forms the distinction of which I have pointed out. These he now regards as valid species, a divergence of view which may appear to some to be merely a matter of opinion. I wish, however, to observe that I feel sure a larger series would have convinced him that intermediate specimens fill up the gap between the extremes shown by his text-figures. To mention only one example, the specimen from Ceylon of which measurements are given in column 10 of my table under *R. tigrina typica* has the metatarsal tubercle in an exactly intermediate condition as regards shape and size.

I have only seen a few living specimens of the Indian frogs, but in dealing with the European *R. esculenta* I have carefully studied enormous numbers, many caught by myself, and I may appeal to experience thus gained, as the distinction between the typical *R. esculenta* and the var. *lessonae* is a perfect parallel to the case of *R. tigrina* and *R. crassa.* The difference between the two extremes, in the proportions of the hind limbs and in the size and *shape* of the metatarsal tubercle is the same, as may be realized from the following measurements (*a*, length from snout to vent ; *b*, length of tibia ; *c*, inner toe, measured from the metatarsal tubercle ; *d*, length of metatarsal tubercle ; *e*, perpendicular diameter of the tubercle) :—

	a.	*b.*	*c.*	*d.*	*e.*
R. esculenta typica, Nice ...	74	37	10	4	1
R. esculenta var. *lessonae*, Norfolk	72	29	8	6	2·5

I add the same measurements of a *R. crassa*, from the Madras Presisency, presented under that name to the British Museum by Dr. Jerdon, which show the inner metatarsal tubercle to be even smaller, in proportion, than that in the *R. esculenta* var. *lessonae*, from Norfolk :—

R. tigrina var. *crassa*	90	42	9	6	2·5

Now it is perfectly well known that there is so complete a gradation between the two extremes indicated by the above measurements that not even the extremists in species multiplication, of which we have a few among European herpetologists, have ventured to separate the form *lessonae* as a species. I have not the least doubt that if a large number of specimens could be obtained, from Ceylon for instance, and carefully measured, the distinction between *R. tigrina* and *R. crassa* would present the same difficulties and fully justify the course I have followed, and prove that, as in the European frogs, geographical non-isolation cannot be appealed to as a safe criterion in deciding what warrants specific rank.

I have one more remark to make, and that is on Wiegmann's figure of *R. rugulosa.* I have re-examined this figure, and, with all deference to Dr. Annandale's opinion, I can only repeat my statement that I regard the snout as pointed, as much so as in Dr. Annandale's figures of *R. tigrina*,[1] and the web between the toes incomplete and deeply notched.[2] It must be borne in mind that the types of *R. rugulosa* and *R. vittigera* have been compared by no less an authority than the late Professor Peters, and pronounced by him to be specifically identical (*Mon. Berl. Ac.* 1863, p. 78).

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[1] Dr. Annandale mentioned as one of the characters of his *R. rugulosa* the less pointed snout as compared to *R. tigrina*, and that is why I draw attention to the shape of the snout in Wiegmann's figure. I therefore request a comparison of the latter with the heads figured on Plate V of the *Mem. As. Soc. Beng.*, Vol. VI.

[2] I have not said that the feet "are meant to be webbed in exactly the same way as in the figure of *R. vittigera* on the same plate," and I know how greatly the extent of the web varies in *R. cancrivora* (see my remarks under that heading). I was alluding to Dr. Annandale's definition on p. 122 of his paper, where *R. rugulosa* is stated to have the feet almost fully webbed and the web very little emarginate.

VIII. THE LYMPH GLANDS IN THE GENUS *PHERETIMA* WITH A NOTE ON THE COELOMIC ORGAN OF BEDDARD.

By GOBIND SINGH THAPAR, *M.Sc., Professor of Biology, Islamia College, Peshawar. (From the Zoological Laboratory, Government College, Lahore.)*

(Plate VI.)

In the common Indian species of earthworms of the genus *Pheretima* there occur on either side of the dorsal vessel throughout the intestinal region a series of segmentally arranged whitish structures which constitute a prominent feature in the ordinary dissection of the animal. Since this genus is usually taken as a type for study in the Colleges of Northern India, and since but little has been published on these organs, I determined, at the suggestion of my Professor, Lieutenant-Colonel J. Stephenson, to investigate them in the three common species of *Pheretima* which occur in Lahore, *P. posthuma* (L. Vaill.), *P. heterochaeta* (Mchlsn.), and *P. hawayana* (Rosa). My grateful acknowledgments are due to Colonel Stephenson for the help and suggestions which I received from him in the course of my work.

Beddard, whose monograph sums up what was known on the Oligochaeta prior to 1895, speaks of these structures along with certain others in other worms as "Coelomic Organs of problematic nature"; "in certain Perichaetidae there are a series of minute paired whitish bodies lying one on either side of the dorsal vessel in the middle region of the body, and springing from the septa (in *P. indica*), or from the dorsal vessel itself (*P. dyeri*). These bodies are quite solid, consisting of a mass of cells surrounding a few muscular fibres." *P. indica* is probably the species now known as *Pheretima heterochaeta*, and *P. dyeri* a synonym for *P. rodericensis*.

G. Schneider published (*Zeit. f. wiss. Zool.*, LXI, 1896) a paper entitled "Ueber phagocytäre Organe und Chloragogenzellen der Oligochäten" (I have not seen his preliminary account, published in Russian with a German abstract in *C. R. Soc. Natural. Pétersbourg* of the previous year). He also investigated *P. indica* and *P. dyeri*, and in addition *P. barbadensis* (a subspecies of *P. hawayana*). According to Schneider the dorsal vessel, at the place of origin of the glands in each segment, lies in a sheath, which is a funnel-shaped forwardly directed diverticulum of the septum; the glands arise from this sheath. The sheath is deficient at a small opening on each side, and from the margins of this opening muscular fibres branch out into the gland; the adjoining segments communicate with each other through this opening. The muscular fibres form the frame-work of the gland, which is not a solid mass, as Beddard states, but a tree-like branching structure, whose twigs in older examples lie so close that the whole gives the impression of a lobed

cell-mass penetrated by numerous canals and lacunae. The cells are thickened peritoneal epithelium ; their nuclei are similar to those of the peritoneal cells on the one hand, and those of the leucocytes on the other ; the outer cells of the gland form rounded projections into the peritoneal cavity. Foreign bodies and parasites are found in the glands, and also setae covered with a thick layer of leucocytes ; in addition to the leucocytes, which make up the bulk of the cells of the glands, there are also large clear cells, with small deeply staining and apparently shrivelled nucleus ; these are sometimes full of small round refractile granules, and mostly occur in small aggregates surrounded by leucocytes ; they are probably dead chloragogen cells. Fresh chloragogen cells are also present in the glands. The author obviously considers the gland-cells to be merely heaped around the supposed opening in the septum. He also describes similar organs in certain Lumbricidae, and performed a number of interesting physiological experiments in order to ascertain the function of the glands ; he comes to the conclusion that they are phagocytic organs.

Schneider introduced the name " lymph-glands " for these structures, which is quite appropriate.

Lloyd (*An Introduction to Biology for Students in India*, 1910) after describing the naked-eye characters of the organs, says " The function of these glands is unknown ; they consist of a mass of nucleated cells, which may be blood cells, or phagocytes in a state of development." He calls them " blood glands," an unsuitable term, which had better be dropped, especially as there are definite blood glands in some species of *Pheretima* (Lloyd's " oesophageal glands ").

METHODS.

The technique employed was the following :—The dissections made in order to describe the form and situation of the glands were made under the binocular dissecting microscope. The worms for sectioning were kept for a week and fed during this time on damp blotting paper renewed daily ; they were then narcotized, and fixed in 10 per cent. formalin for 24 hours, then washed and passed through graded alcohols ; some were cut into pieces and fixed in warm sublimate and acetic for an hour, then washed several times in distilled water and passed through graded alcohols.

The sections were first overstained with Delafield's haematoxylin and then differentiated in acidulated water (five drops HCl to 100 cc. distilled water ; I used acidulated water in preference to acid alcohol because in the latter case there is no graduated and regular transference of the sections from a watery to an alcoholic medium). After passing through graded alcohols up to 90 per cent. the sections were counter-stained in alcoholic eosin (1 per cent. eosin in 90 per cent. alcohol for one minute), then dehydrated and cleared in the usual way.

I also used Dobell's iron-haematein method (*Arch. Protistenkunde*, XXXIV, 1914). Films of the coelomic fluid, which I examined in the course of my work, were fixed in either sublimate or absolute alcohol, and stained in a similar manner to the sections.

THE GLANDS AS SEEN IN DISSECTION.

Pheretima hawayana.—The lymph glands are a double series of whitish bodies, situated on either side of the dorsal vessel, lobulated, segmentally arranged, beginning in segm. xxvi. In the anterior portion of their extent they occupy the posterior third of each segment, and extend from the dorsal vessel outwards about half way towards the lateral margin of the intestine. As we pass backwards they enlarge, until in the middle region they cover the greater part of the intestine in each segment (fig. 1). Still further back they diminish again, and ultimately they totally disappear in the last two or three segments. Each consists of a large number of very closely set small lobules.

The septa are pouched forwards where they cross the dorsal vessel so that the dorsal vessel is here enclosed in a tube-like sheath, the cavity of which is part of the cavity of the segment behind the septum. It is to the walls of this pouch that the glands are connected.

On some of the glands a number of small white bodies are to be seen, which on examination are found to be the cysts of the spores of a Gregarine,—probably of the *Monocystis* found in the seminal vesicles.

Pheretima heterochaeta.—The glands begin in segm. xvii. In the anterior part of their extent they appear attached by a short stalk; behind, the glands enlarge and a stalk is not to be distinguished; at the hinder end the glands of a pair meet and fuse over the dorsal vessel and below it, so that the vessel is enclosed by the glands. The glands are of simpler form than in *P. hawayana*,—not lobulated in the same way; though towards the hinder end a number of lobes, with a digitate arrangement, may be present (fig. 2).

Pheretima posthuma.—The glands begin, as in *P. hawayana*, in segm. xxvi; the lobulation and variations in size correspond to what was found in that species; some of the glands also show the spore cysts of Gregarines.

HISTOLOGY OF THE GLANDS.

A detailed description need only be given for one species; for this purpose I choose *P. hawayana.*

The lobules of the gland surround a central cavity, and this cavity opens into the cavity of the sheath round the dorsal vessel at this region; the interior of the gland is therefore morphologically in connection with the cavity of the segment behind that in which the gland itself lies. Fig. 3, actually drawn from *P. posthuma,* will illustrate this relation.

The boundary of the gland consists of an extremely fine membrane, in which nuclei appear at intervals as flattened swellings; these ovoid nuclei contain a deeply staining granule (" pseudonucleolus "), as well as fine irregularly distributed chromatin particles; the protoplasm surrounding the nucleus appears to be fibrillar in structure, and is continued into the membrane which forms the boundary of the gland.

Besides this bounding membrane, the interior of the gland is traversed by a reticulum, sometimes comparatively sparse, of the same character,—much flattened cells joined end to end,—and continuous with the limiting membrane, or capsule, as it may be called. In the centre of the gland this reticulum is almost or quite absent, so that there

is there an uninterrupted space, containing more or fewer of the cells to be described ; this space, as has been mentioned above, opens into the cavity of the sheath round the dorsal vessel.

From the margins of this opening, *i.e.*, from what may be called the mouth of the gland, a number of muscular fibres take origin, as has been described by Schneider ; these pass into the gland, and then branch and radiate ; they are perfectly distinct from the reticulum.

Within the gland are contained numerous cells, of irregular shape, with rounded nucleus containing a pseudonucleolus ; their processes may resemble pseudopodia, and the nucleus may be excentric. These are leucocytes, and as their characters are well known, they need not be further described.

These cells are more compactly aggregated at the periphery of the gland, where they form fairly solid masses corresponding to the lobulations seen on the surface ; each such lobule is surrounded by a corresponding outward bulging of the enveloping membrane or capsule. The cells are also contained in the meshes of the reticulum of the gland, but are here more loosely aggregated ; in the centre of the gland towards the opening into the sheath of the dorsal vessel they are still more scattered.

The cells are to be looked on as proliferated from the inner surface of the capsule within the peripheral lobulations ; thence they travel into the central part of the gland, and ultimately they reach the general body-cavity through the sheath around the dorsal vessel, which, as already explained, communicates with the cavity of the next posterior segment.

From what has been said, it will be seen that I regard the capsule as peritoneal in origin ; it is indeed, as fig. 3 shows, continuous with the septum, and may be looked on as in fact an irregular sac-like forward bulging of the septum, which has become extremely thin by the loss of all muscular elements,—which has been indeed reduced to a thin sheet of peritoneal cells only. No doubt this sheet is morphologically double, and results from the coalescence of the two layers of peritoneum covering the two faces of the septum, but its double character is not to be made out in the actual specimens.

I differ, therefore, from both Beddard and Schneider in the conception of the essential nature of these organs ; neither author seems to have recognised the capsule, or bulging of the septum within which the cells are contained. Beddard's idea is that the organ is a mass of cells surrounding a few muscular fibres ; while Schneider speaks of a definite opening in the sheath of the dorsal vessel, through which the cavity of one segment communicates with that of the next adjacent, and the gland is a tree-like branching structure originating from the margins of the opening.

I must guard myself from saying that the capsule is to be made out as a complete investment over the whole periphery of the gland in every section ; it seldom is so, in this species at any rate. At places the cells of the gland are closely adherent, so that the capsule does not stand off as a separate structure, and frequently the capsule is absolutely continuous with the cells. This of course necessarily follows from the

fact that the cells are budded off from the inner surface of the capsule. It is possible also that some cells are budded from the outer surface of the membrane ; or the cells which may be seen there may perhaps be leucocytes of the coelomic fluid which have become temporarily adherent.

In *Pheretima heterochaeta* the lobulation of the glands is less marked than in *P. hawayana*, and the outline of the glands in sections is comparatively smooth ; there is consequently not the same massing together of the newly formed and forming cells within the lobules, and the texture of the gland seems on the whole to be looser ; the capsule is as a rule more easily traced, and its connection with the reticulum within the gland is easily made out.

In *P. posthuma* the lobulation is similar to that of *P. hawayana*, and the relation of the capsule to the cells also is as described for that species.

OTHER CONTENTS OF THE GLANDS.

That the main mass of the cells of the glands are leucocytes with a phagocytic function has been established by the experiments of Schneider.

In addition I have seen the cells described by Schneider as containing small round refractile granules ; the cells may be partially or even entirely filled by the granules. Chloragogen cells are also to be seen, and may be met with in various stages of degeneration. Cysts and pseudonavicellae of *Monocystis*, which may be surrounded by an almost epithelial arrangement of leucocytes, are present. Setae and fragments of setae, similarly surrounded by leucocytes, are also found.

THE COELOMIC FLUID IN *PHERETIMA*.

I add a few notes on the coelomic fluid in this genus.

The fluid is of a yellowish colour, which varies according to the nature of its cellular contents. Its consistency also varies ; it is thick and gelatinous in specimens coming from a dry locality, thinner in those from places where there is abundant moisture. As is well known, it is coagulable by alcohol.

Its cellular constituents are of four chief kinds :—

(1) Leucocytes, granular and colourless, of various sizes ; the nucleus is usually spherical, and excentrically placed ; the chromatin is distributed as irregular granules, while in the middle of the nucleus is a larger aggregate, which may be called the pseudonucleolus. In normal salt solution these cells are seen to be actively putting out pseudopodia, fine filiform processes extending in various directions, which may anastomose with similar pseudopodia of other cells and lead to the production of plasmodia. The cells may sometimes become pear-shaped, with a fine filiform process which gives the appearance of a flagellated Protozoon till the movements are observed.

(2) Minute colourless nongranular cells, mostly spherical, but sometimes becoming elongated and pointed at the ends ; they are numerous, and may also form plasmodia. In stained preparations the clear protoplasm readily takes up the eosin stain ; the nucleus when present is

excentric, spherical, and contains a pseudonucleolus; there is a large clear vacuole in the middle of each.

(3) The cells described in the account of the lymphatic glands as containing a number of refractile granules or globules are also seen.

(4) Yellow cells,—the chloragogen cells,—in various stages of degeneration are found.

In addition, numerous rod-like bacteria are present; and also the sporozoite stage in the development of *Monocystis*.

THE COELOMIC ORGAN OF BEDDARD AND FEDARB.

Beddard and Fedarb have described ("On a new Coelomic Organ in an Earthworm," *Proc. Zool. Soc.*, 1902), in specimens of *Pheretima posthuma* sent from Calcutta by Mr. F. Finn when Deputy Superintendent of the Indian Museum, a number of pouches or tunnels on the inner surface of the body-wall. These, which were visible in the ordinary dissection of the worms, were found in a number of specimens,—it is not stated that they were absent in any. Their direction is transverse on the lateral and ventro-lateral body-wall; they occur on both sides, from segment xxii to the hinder end of the animal, being largest from about segment xl for about twenty segments onwards. Extending outwards and upwards from near the ventral nerve cord, they present the appearance of tunnels open at both ends, considerably constricted in the middle of their extent; or the two halves may be quite separate, *i.e.*, the constriction may be complete, resulting in the formation of two pouches on each side, those on the same side having their mouths facing in opposite directions, their narrow closed ends close together. The roof of the tunnels or pouches is thin and membranous,—merely an extension of the peritoneum. The structures are not equally marked in all specimens; but, as stated above, they are not said to have been absent in any of the specimens examined.

In a large number of dissections of *P. posthuma* I was unable to see these organs, even with the binocular dissecting microscope. I also prepared several series of sections for the same purpose, but the results were here also negative, except in one case, in a few segments taken from a little in front of the middle of the body. Here the tunnel was present, as described by the authors; while reaching to not very far from the ventral nerve cord below, they terminated above a little dorsal to the lateral line of the body.

The organs are therefore not found in all specimens of the species; in some localities, as at Lahore, they appear to be of rare occurrence.

A point not noticed by the previous authors is the modification of certain cells of the roof of the tunnel. A section across the tunnel,—such as is obtained in a longitudinal vertical series where it passes through the lowest part of the tunnel on the ventral body-wall,—shows the floor to be flat, and the roof a semicircular arch, just as in an ordinary railway tunnel (fig. 4). The floor is carpeted by ordinary peritoneal cells, clear and squarish; the sides of the arching roof consists of flattened cells joined at their edges, as in the case of the capsule of the lymph glands, previously described. The vertex of the roof is peculiar; it consists of cells which are much elongated vertically, joined together

at their bases, and projecting downwards into the tunnel, with their free ends, which are narrower than the bases, separate from each other, and so giving a ragged appearance to the lower side of the roof; the length of these downwardly projecting cells may be more than one-third of the height of the tunnel; they have a fibrillated structure, the fibrils running in the direction of the long axis of the cells.

In the tunnels numerous leucocytes are seen, and many nephridia, as mentioned by Beddard and Fedarb. I have no suggestions to offer as to the function of these organs.

EXPLANATION OF PLATE VI.

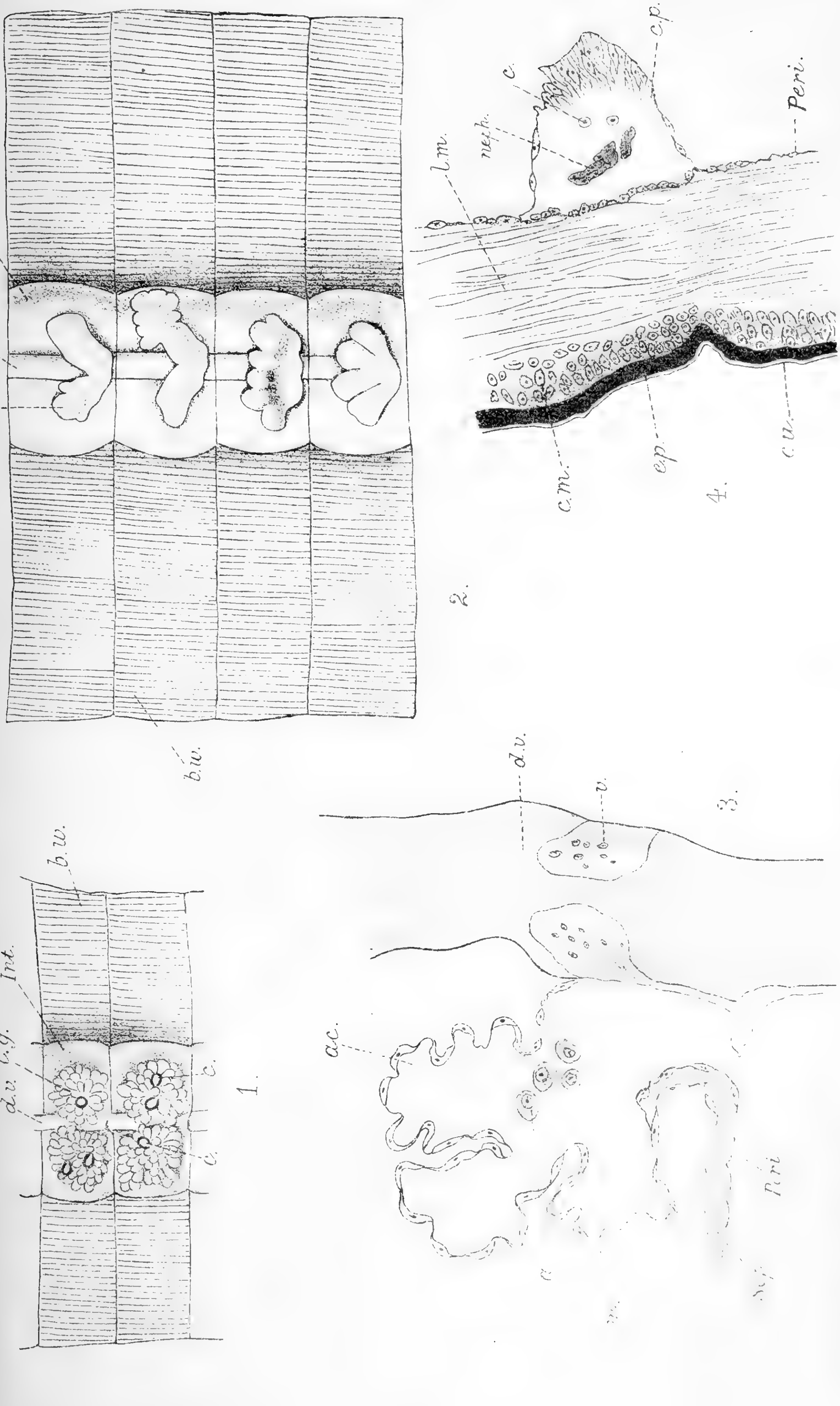
FIG. 1.—Dissection in the middle region of *Pheretima hawayana* ; *b. w.*, body-wall ; *c*, spore cysts of *Monocystis* ; *d. v.*, dorsal vessel ; *int.*, intestine ; *l.g.*, lymph gland.

,, 2.—Dissection in the posterior region of *Pheretima heterochaeta* ; letters as before.

,, 3.—Horizontal longitudinal section through a lymph gland of *Pheretima posthuma*, showing relations to the septum and dorsal vessel ; only a few cells are shown in the interior of the gland, and the reticulum and branching muscular fibres are omitted ; *a*, a leucocyte ; *ac.*, one of the peripheral lobules of the gland ; *d. v.*, the dorsal vessel ; *m*, encapsuling membrane of the gland ; *peri.*, peritoneum ; *sep.*, septum ; *v*, valve in dorsal vessel.

,, 4.—Vertical longitudinal section passing through the lower end of Beddard and Fedarb's organ ; *c*, leucocyte ; *c.m.*, circular muscular layer ; *c.p.*, coelomic organ ; *cu.*, cuticle ; *ep.*, epithelium ; *l.m.*, longitudinal muscular layer ; *neph.*, nephridium ; *peri.*, peritoneum. The epithelium is shown as a thick black line only.

Figs. 3 and 4 are semidiagrammatic.



A. Chowdhary lith.

IX. NOTES FROM THE BENGAL FISHERIES LABORATORY.

No. 4. CESTODE PARASITES OF HILSA, *HILSA ILISHA* (Ham. Buch.).

By T. Southwell, *A.R.C.Sc.* (*Lond.*), *F.Z.S.*, *Director of Fisheries, Bengal and Bihar and Orissa ; Honorary Assistant, Indian Museum, Calcutta, and* Baini Prashad, *M.Sc.*, *Superintendent of Fisheries*,

(Plates IV, V.)

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I. THE ANATOMY AND LIFE-HISTORY OF *RHYNCHOBOTHRIUS ILISHA*, n. sp., FROM THE INTESTINE OF *CARCHARINUS GANGETICUS* (Müll. and Henle).[1]

During September and October, 1917 observations were made by us in the Pusser river, district Khulna, on the habits of Hilsa, *Hilsa ilisha* (Ham. Buch.). This anadromous fish ascends the Bengal rivers, during the rains, for the purpose of breeding. Two methods of catching the fish are practised by the Bengal fishermen :—

(1) Small canoes drift down stream, broadside on, trailing behind them a *shangla jal*. This is a small purse-like net which can be manipulated easily by one man. The moment a Hilsa is caught, the mouth of the net is closed, the net is hauled aboard, the fish removed, and the net cast over again. By this method it is very rare for more than one fish to be caught at a time.

(2) A large gill-net, often measuring 300 feet in length, is shot by one, or between two, boats, and allowed to drift downstream for perhaps two miles or so. It is then hauled. The catch varies between two or three fishes and two hundred.

In both cases, the boats return to the starting point, picking their way close to the bank of the river, aided by the wind, which fills a big sail of fantastic shape and colour. In both the above methods of fishing the entry of a fish into the net is most easily detected. Whilst working with the gill-net, we frequently noticed that fish entered the net, but somehow escaped. On hauling the net it was in every case found to be torn. The fishermen assured us that the damage had been

[1] *Carcharius gangeticus* (Müll. and Henle) in Day's Fishes in the "*Fauna of British India*."

done by a shark, and that sharks frequently attacked and ate Hilsa from the large net. A few days later we were fortunate in catching a shark in one of the small *shangla jals*. It proved to be a specimen of *Carcharinus gangeticus* (Müll. and Henle), which measured a little over 6 feet. The stomach contained a Hilsa, partly digested, and also a portion of the net. On examining, carefully, the partly digested Hilsa, it was found that the flesh of this fish contained numbers of club-shaped Cestode cysts, which, as a result of the partial digestion of the fish, were actively emerging from the flesh into the stomach of the shark. These cysts, which occurred in the muscles, had not been noticed previously. The large intestine of the shark contained numbers of adult Cestodes, but the spiral valve was clean. These parasites were found, ultimately, to be of two species, *viz.*, (1) *Discocephalum pileatum*, Linton. The only species of the genus was recorded by Linton from the spiral valve of the dusky shark *Carcharius obscurus* ? Woods Hole, Mass., July 19th, 1886; it has not been recorded since. (2) *Rhynchobothrius ilisha*, n. sp., which forms the subject of this paper. All the cysts seen emerging from the partly digested Hilsa were found to contain larvae of *Rhynchobothrius ilisha*. No cysts were obtained which contained larval forms of *Discocephalum pileatum*, Linton. De, in his report on the "Fisheries of Eastern Bengal and Assam," Shillong, 1910, mentions that sharks and saw-fishes follow the Hilsa up the rivers of Eastern Bengal and Assam. This is certainly true of *Carcharinus gangeticus*.

Systematic position.

Family Tetrarhynchidae.
Sub-tribe Trypanorhyncha, Diesing.
Sub-family Phyllorhynchinae, Van Beneden.
Sub-family I. Dibothriorhynchinae.
Family Dibothriorhynchidae, Diesing.
Genus *Rhynchobothrius*, Rudolphi.
(*Tetrarhynchus* of authors.)

Generic characters :—Body taeniform. Neck tubular. Head continuous with neck, with two opposite bothria, parallel or converging at the apices, lateral or marginal, entire or undivided, or, either bilocular with a longitudinal partition, or bilobed or divided. Proboscides four, terminal, filiform, armed, retractile in the neck, for the most part longer than the head. Genital apertures marginal, female lateral, or male and female marginal approximate.[1]

Rhynchobothrius ilisha, n. sp.

(Plate iv, figs. 1—7.)

Bothria two, lateral, entire, rounded, external face hollowed to form a sucking disc; widely separated posteriorly, and approximated anteriorly. Neck shorter than the head, flat. Proboscides filiform and armed with four kinds of hooks, arranged in oblique circles, the larger

[1] After Linton (2).

hooks being distributed principally on the outer surface. Anterior segments shallow and numerous. Last segment much longer than head. Total number of segments about 232. Genital apertures irregularly alternate, and situated about the posterior third of the proglottid. Length of worm 11·5 cms. Posterior segments separating in two's and three's.

Habitat.—The large intestine of *Carcharinus gangeticus* (Müll. and Henle). Khulna, district Khulna, Bengal, 21st October 1917. Eleven adult specimens, several young forms just emerged from the cyst, and three cystic forms. No. Z.E.V. $\frac{7248}{7}$ in the collection of the Indian Museum.

Observations were made on the adult living worms and also on the free proglottides, in fresh water. Later on, these were preserved in corrosive acetic solution. Specimens were mounted stained whole with borax carmine, and also unstained. Sections were not found necessary as the anatomy could easily be determined from the mounted specimens. The head is large compared with the size of the worm and measures 4·2 mm. in length. The breadth of the anterior extremity is 2·6 mm., and of the posterior extremity 1·4 mm. Length of bothridia 1·8 mm. Length of proboscides 2·1 mm. Length of proboscis sacs 1·6 mm.

The bothridia (B) are paired, approximated anteriorly and widely separated posteriorly (plate iv, fig. 2). They are round in shape, having entire margins, and sucker-like external surfaces. The proboscides (P) are four in number; the armed portion is very short, with an equal length unarmed and very long tubes connecting them to the proboscis sacs (P. S). The hooks (plate iv, fig. 2 *a*—*e*) are of four types arranged in oblique rings, the larger ones being disposed along the outer margins. As usual, the hooks towards the base of the proboscides are much smaller than the rest.

The neck is short, measuring only 2·2 mm. It is flattened and not cylindrical. The anterior proglottides are shallow and numerous. The posterior proglottides are much longer than broad, measuring 5·1 mm. by 1·3 mm. The total number of proglottides is about 232. The male genital organs appear first. The female organs are to be seen only in the last few proglottides. Of the male organs, the testes are first visible about the middle of the worm. The genital aperture is situated about the posterior third of the proglottis, and the male aperture is immediately in front of that of the female.

Male organs (plate iv, fig. 4).—These consist of a large number of testes (T) occupying the greater part of the mature proglottid. They first appear laterally. From each of these is given off a minute tubule; these unite later to form the vas deferens (V. D). This is a thick coiled tube originating a little in front of the ovaries and opening directly into the cirrus sac (C). The vesicula seminalis (V. S) is a bag-like structure which opens close to the junction of the vas deferens and the cirrus sac. The penis is fairly long and lies coiled up in the spacious cirrus sac. We could not distinguish any armature.

Female organs (plate iv, fig. 4).—The ovaries (Ov) are paired and lie one on each side of the centre line, posteriorly. From each is

given off, anteriorly, a very small oviduct (O.d). The two oviducts unite in the middle-line and receive, at the point of junction, the duct of the shell-gland (S. G). This organ lies between the ovaries, in the centre line. The uterus (Ut) originates, anteriorly, from the point of union of the two oviducts. It runs forward in the middle-line as a blind diverticulum, practically to the anterior termination of the proglottid, narrowing as it goes. The vagina (V) also originates close to the mouth of the uterus and is continued as a narrow coiled tube to near its opening. It then widens to form a barrel-shaped receptaculum seminalis (R.S).

Water-vascular system (plate iv, fig. 3).—This consists of a single pair of wide tubes (W. T), situated one on each side, internal to the excretory vessel and nerve. These two tubes communicate with each other by a wide transverse vessel situated at the posterior margin of each segment. In the head, the two tubes break up into a series of fine vessels distributed throughout the substance of the head.

Excretory system (plate iv, fig. 3).—This consists of a pair of very fine tubes (E. D) situated, one on each side, between the water-vascular vessel and the nerve. In the proglottides, they do not unite, but in the head they are united by a single transverse vessel.

Nervous system (plate iv, fig. 3).—In each proglottid this consists of a single fine nerve (N) on each side, external to the water-vascular and excretory duct. No attempt was made to follow the distribution of the nervous system in the head.

The larva.—We have already referred to the fact that numbers of tadpole-like cysts were found in the lateral muscles of the partly digested Hilsa. Previous to this record no cysts had been noticed in the flesh of Hilsa, although some time ago larval forms of *Syndesmobothrium filicolle*, Linton, were recorded by one of us from the mesenteries of this fish (5 & 6). The *Rhynchobothrius* cysts were, as noted, tadpole-shaped (plate iv, fig. 5). They consisted of a club-like head, and a long tail-like structure which was capable of considerable movement, and appeared to us to serve the purpose of mooring the larva in the intestine of the shark, during the digestive processes.

The head, in one specimen, measured 4·8 mm. by 3·6 mm. The tail tapers to a point and measured 51·8 mm. in length. On opening out the " head," the larva (Y) was seen to be a massive structure occupying the greater part of the head and lying in a coiled position (plate iv, fig. 6). The tips of the four proboscides were just everted, and the spines could be clearly seen. Many young worms (plate iv, fig. 7) were also obtained from the lumen of the intestine. These had not had time to attach themselves to the intestine of the host.

Life-history.—The Cestodes usually complete their life-histories in two separate hosts, the larval form occurring in an animal which is devoured wholly, or in part, by the final host of the worm. In a great number of cases the larval forms of adult worms have not been recorded. In fewer instances larval forms have been described, but the adult worm developing therefrom is not known. The circumstances under which we are able to follow the life-history of this worm are undoubtedly unique. In the present instance, the larval form of *Rhyn-*

chobothrius ilisha occurs in the lateral muscles of Hilsa. This fish is eaten by the shark *Carcharinus gangeticus,* and practically all stages between the cystic form and the adult worms are to be found in the intestine of the shark in question.

Three points arise for consideration :—

(1) We have already called attention to the fact that the tail of the tadpole-like cyst is mobile. It appeared to us on examining the living material, *in situ,* that the movements of the tail were directed toward retaining the cyst in the lumen of the shark's intestine, until the larva had had time to emerge and attach itself to the wall of the gut.

(2) We have no information as to the exact manner in which the Hilsa become infected. The eggs of the adult worm are obviously shed into the water. Most probably they are swallowed accidentally by the Hilsa, in which case the larva would be liberated and carried to the muscles, *viâ* the lymph or the blood stream. It is further possible that the larvae hatch out in water, and, attaching themselves to the Hilsa, bore their way to the lateral muscles ; but as we know nothing regarding the structure of the larva, we can only hazard a guess as to the initial mode of infection of the Hilsa.

(3) It will be clear that parasites occurring in the intestines of fish are removed with the entrails of the fish, before the fish is cooked and eaten. But when these parasites occur in the flesh, their removal is impossible.

Rhynchobothrius ilisha, n. sp., is the first example of an Indian Cestode whose life-history has actually been worked out. It is true that in the cosmopolitan forms of tapeworms, such as *Taenia solium, Taenia serrata,* etc., the life-history is well known. In India, owing to the occurrence of these species in precisely similar hosts, the same life-history has been inferred ; but so far as we are aware no experimental work of this kind has been attempted.

Shipley and Hornell (4) described two species of tapeworms from *Carcharias gangeticus* (now *Carcharinus gangeticus*) obtained in Dutch Bay, Ceylon (salt water), 3rd January 1905, *viz., Tertrarhynchus perideraeus* and *Tetrarhynchus gangeticus.* Our species is totally dissimilar to the former and differs in the following particulars from *Tetrarhynchus gangeticus* :—

1. Our worms are 17 times longer.
2. A distinct neck is present.
3. The arrangement of the proboscis tubes is quite different.
4. The hooks are different.

As nothing has been stated by the authors regarding the anatomy of their species we have no means of carrying the comparison further. Our species is quite different from other species of this genus.

Four species of Cestoda have now been recorded from this shark, *viz., Tetrarhynchus perideraeus, Rhynchobothrius ilisha, Tetrarhynchus gangeticus,* and *Discocephalum pileatum.*

Classification.—As a result of some years' observations on the Tetrarhynchidae we are of opinion that this family requires revision, particularly with reference to the anatomy of the reproductive organs. Fortunately, we have a fairly extensive and representative collection

and we are hoping, at no distant date, to be able to determine, in detail, the exact relationships of the various genera included in this family.

The anatomy of the reproductive organs in our species is quite unlike that given by Linton (2) for the various species of Rhynchobothridae recorded by him. On the other hand, it resembles very closely the figure of an immature proglottid of *Tetrarhynchus erinaceus*, Ben., figured by Johnstone (1). It differs only in the absence of vitellaria and a few minor details.

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II. A NOTE ON THE CYSTS OF *SYNDESMOBOTHRIUM FILICOLLE*, LINTON, PARASITIC IN THE LATERAL MUSCLES OF HILSA.

Specimens of Hilsa purchased from the Calcutta market during October, 1917 were found, on careful examination, to contain cysts of *Syndesmobothrium filicolle*, Linton, in their flesh (lateral muscles).

Southwell (3) recorded specimens of this cyst from the mesenteries of Hilsa in 1913. This parasite is, of course, distinct from the cysts of *Rhynchobothrius ilisha*, Southwell and Prashad, described in the first part of this paper.

The cysts, when removed from the muscles, showed a considerable amount of movement and remained alive in normal salt solution for a few hours. Both the head and tail of the tadpole-shaped cysts (plate iv, fig. 8) were mobile. The head, in addition, showed contractile movements, owing to which its shape exhibited great variation in form.

The cysts measured about 64 mm. in length, the head being 5·7 mm. long by 3·1 mm. broad, whilst the tail varied in length from 58 mm. to 60 mm. The tail was an elongated tapering structure. The cysts were of a milky-white colour, the head being formed of stout fibrous tissue, whilst the tail portion consists of a thin membrane enclosing an albuminous fluid.

On one of these cysts being dissected out it was seen that the head portion contained a second cyst (Y), almost cylindrical in shape, transparent, and 3 mm. in length.

This second cyst, on being opened, was found to contain the worm (plate iv, fig. 9), which showed four fully developed bothridia and four proboscides, with a neck and an undifferentiated part posteriorly, which terminated in a vesicle.

The parasites were not very numerous in the specimens of Hilsa which we examined.

Literature cited—

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III. A DESCRIPTION OF A CESTODE PARASITE OF DOUBTFUL SYSTEMATIC POSITION, FROM THE MESENTERY AND LIVER OF HILSA.

I. INTRODUCTION.

In the following paper we propose describing a parasite which, though of small size, appears to be of very great systematic importance, and which further reproduces itself in a manner not before known amongst the Cestoda.

The parasites were found first at Khulna in the mesentery of Hilsa. The mesentery (*m*), binding up the various coils of the intestine, was infected so very heavily as to appear something like a massive liver-like organ in which the various coils of the intestine appeared merely as tubes embedded therein. The infection had further spread to the liver [L (i)] which, in most specimens examined, was also heavily infected, though only in part (plate v, fig. 1).

Since the initial observations were made, the parasites have been found to be widespread. They were found in Hilsa examined by us from Goalundo, Sahebgunj, Kalna, and Calcutta. The infection is of such a heavy nature that, although more than a hundred specimens have been examined, not a single one was found which was not similarly infected. Continuous observations on living and preserved material were made at Khulna and Kalna and in the Fisheries Laboratory in the Indian Museum, over a considerable length of time. It has thus

been possible not only to make exact observations on the parasite, but also to refer to all the literature found necessary. The adult parasites, as found in the mesentery, lie in elongated cysts of a creamy-yellow colour. The cysts measure 2·5 to 3 mm. in length. The younger stages are found scattered in the mesentery, the cyst not having been secreted at this stage.

II. TECHNIQUE.

Living worms are dissected out of the cyst in normal salt solution, under a binocular microscope, and are examined alive on a slide with the highest powers available. They are best preserved for whole mounts in an alcoholic solution of Schaudinn's corrosive acetic solution. The salt solution containing these dissected out worms on the slide is first drained off and a few drops of the fixative added to cover them. After about half an hour the fixative is drained off and the usual method of staining and mounting adopted. We found that Heidenhain's iron haematoxylin gave the best results. Serial sections of the worms were cut with a Minot's rotatory microtome and stained with Heidenhain's iron haematoxylin.

III. THE ANATOMY AND DEVELOPMENT OF THE ADULT WORM.

(1) *The Cyst* (plate v, fig. 2).—The worm occurs, as we have already remarked, in an elongated cyst which varies from 2·5 to 3 mm. in length. Its width is usually ·4 to ·5 mm. The cyst is cylindrical and rounded at both ends. It is made up of strong fibrous tissue. On opening out the cyst it is found to consist of a single adult worm, with a few young worms which have been produced pathenogenetically in a manner to be described later on. The worm is attached to the internal wall of one of the rounded ends of the cyst by four suckers, which occur at the anterior end of the worm. The anterior extremity of the cyst, which is the same as that of the animal, can easily be distinguished under a lens, or the binocular microscope, owing to a reddish-orange pigment shining through the cyst at this end. It may be stated here that the cyst is in no way secreted by the parasite, but is formed by the tissues of the host itself undergoing a change. Besides the worm, the cyst contains a large number of fat globules and fat cells, which appear to serve as food for the parent worm.

(2) *The adult worm* (plate v, fig. 3).—The adult worm is a leaf-like animal resembling a small liver-fluke. It measures 2·4 mm. long and ·38 mm. broad. These measurements refer only to the fully grown animals found in the cyst. It is of a milky-white colour, with two more or less triangular patches of orange-red pigment (P.C.) situated near the anterior end, just posterior to the suckers, one on either side. The worm, on examination under a microscope, is seen to consist of an anterior and a posterior extremity. Anteriorly there is a median rostellum-like structure (R), devoid of any armature. Immediately posterior to it are four typical suckers (plate v, fig. 4), arranged symmetrically round the base of the rostellum. These are circular, having deep concavities, with thick raised, entire, margins. The usual three

kinds of muscles can be distinguished as forming the structures in question. The posterior extremity of the worm is rounded. No opening whatsoever is to be seen at this extremity. The outer cuticle is somewhat thickened.

(3) *Internal structure of the worm.*—On examining the worm with the high power it is seen to consist of a homogeneous substance in which no differentiation into separate organs is to be observed. In fact, the structure is of a most primitive character. All that can be distinguished besides the egg-cells (E) and the coloured corpuscles, in both living and stained specimens and in sections, is a tube, slightly coiled, which runs round the worm, close to, and parallel with, the margin of the leaf-shaped worm. Anteriorly, near the suckers, the two ends curve inwards for a short distance towards the centre of the worm. This is the excretory tube (E.t.), and from it are given off a large number of minute tubules which end in typical flame cells. The flame can, with an oil-immersion lens, be seen moving in these cells, in the living worm. The whole of the homogeneous substance referred to above is filled up with enormous numbers of minute egg-cells. Besides the eggs, *morulae* [(E (i)] and other higher stages in the development of the young were also present in the intima.

The orange-red coloured corpuscles (P. C.) are arranged in two triangular patches, one on each side, immediately behind the suckers. Each of these patches is formed of a large number of nearly rounded corpuscles measuring 23-25 μ in diameter. We are unable to say anything regarding the function of these corpuscles. When the worms die, or are preserved, the pigment disappears.

(4) *Egg-cells.*—The egg-cells (plate v, fig. 5) are elliptical, measuring 17 μ by 12 μ. The structures of the egg-cells is the same as that of a typical ovum with little yolk, and they probably originate in the same way as the parthenogenetic egg-cells in the sporocysts (and other larval stages) of the Trematodes. Some of these egg-cells were seen to be in different stages of development (plate v, fig. 6). They develop in the body of the parent to form young worms identical in structure and appearance with the parent. These will be fully described later on. Under ordinary circumstances the anterior extremity, or rostellum, of the adult worm shows no opening, but, when the development of the parthenogenetic young worms is complete, it is seen that the young worms have gradually worked their way to the anterior extremity of the adult. They now escape through a temporary aperture which is formed in the middle of the rostellum, anteriorly. In plate v, fig. 7 one such young worm is shown in the act of escaping. We were fortunate in being able to observe two such cases, on different occasions, in living animals under microscopic observation. After the parent form has produced numbers of such young, the cyst breaks up and the young escape into the mesentery of the host. The parent form now dies and many empty cysts can always be seen in the mesentery of the host.

(5) *The young worms* (plate v, fig. 8).—These vary in size from ·3 mm. to ·35 mm. in length by ·1 to ·12 mm. in breadth. They, like the adult worm, possess four suckers, a rostellum, imperfectly developed excretory tube, and a few eggs, but are devoid of pigment.

IV. SYSTEMATIC POSITION OF THE WORM.

It will be clear from the preceding description that the parasite presents many unique characters. Our first impressions were that the parasite was a Trematode, but subsequent investigation showed that this was not the case. The entire absence of an alimentary canal, and the presence and arrangement of the four suckers, suggested the probability of the parasite being a Cestode, and it was only after careful examination that we concluded, definitely, that the animal belonged to the Cestoda.

Benham (1) defines the characters of the Cestoidea and the Trematoda as follows :—

(1) *Cestoidea.*—Platyhelminths in which an internal parasitic *habit has led to the disappearance of the alimentary canal from every stage in the life-history.*[1] The ciliated covering, as well as definite organs of sense, are likewise absent in the adult. The epidermis, which has sunk into the parenchyma, secretes a thick cuticle as in the Trematoda. In the parenchyma, certain lime-secreting cells are developed in greater or less number. Organs of fixation are developed in a characteristic, but varied form, at one extremity of the worm.

(2) *Trematoda.*—Parasitic Platyhelmia which retain the mouth and alimentary tract of the ancestor, but in which the epidermis not only loses its cilia during embryogeny but is apparently absent in the adult as a distinct continuous cellular layer, having sunk into the mesoblastic tissue after secreting a thick, stratified, chitinous cuticle. Further, in relation to their parasitic habits, suckers are developed at, or near, the posterior end on the ventral surface and also in the region of the mouth.

In considering the classification of the worm just described, three points are to be considered, *viz.* :—

(1) Is the animal a Trematode or a Cestode ?
(2) Is it a larval form or an adult ?
(3) If an adult, then is it a primitive or a degenerate form ?

(1) Is the animal a Trematode or a Cestode ?

The entire absence of all traces of an alimentary tract, the disposition of the suckers, and the absence of ventral posterior suckers are definite Cestode characters which, in our opinion, show that the worm is not a Trematode. The absence of an alimentary canal alone is considered by Luhé, and other leading helminthologists, to be the chief distinguishing character between Cestodes and Trematodes, although in some stages of the life-history of a few Trematodes, owing to degeneration, all traces of an alimentary canal disappear. We were unable to establish, by experiment, the actual presence of calcareous bodies, although under the microscope, typical calcareous bodies appeared to be present. The occurrence of orange-red corpuscles is an incidental character which it shares in common with many adult Tetrarhynchids, but we are not aware of any record of such coloured bodies being found in the Trematodes. Although the parasite seems to us to be undoubtedly a Cestode, we are aware that it differs very widely from

[1] The italics are ours.

any larval or adult Cestode hitherto described. These differences, as we shall see, are so great and so fundamental as to merit very careful consideration before coming to a conclusion.

(2) Is the parasite a larval or an adult form ?

Assuming it to be a larval form the following facts have to be considered :—

(*a*) The parasite exhibits, in common with the larval liver-flukes, the peculiar method of parthenogenetic development, but we know of no case among the Trematodes in which such active larval stages are passed in a vertebrate host. Further, nowhere does this type of parthenogenetic development take place within a cyst. Besides this, as the parasite in question has absolutely no trace of a digestive tract, we have no hesitation in concluding that it is not a Trematode larva.

Turning now to the Cestoda we find that the reproductive process is absolutely unique, whether the parasite be an adult or a larval form. It is unlike any Cestode larva we are acquainted with in being parasitic, absorbing food, reproducing itself, and in the progeny reinfecting the same host. Further, a combination of such adult structural characters as suckers, reproductive organs of whatever kind, and the excretory duct, is not to be seen in any larval Cestode. We are aware of the conditions existing in various species of the genus *Piestocystis* (3). We have seen Villot's account (6) of this form, as well as Hill's description of his species of *Piestocystis hoplocephali* and *Piestocystis lialis* (4). Although our form bears a superficial resemblance to *Piestocystis lialis* with the head evaginated, in having an unarmed rostellum and four suckers, yet our species, though encysted, has the rostellum and suckers always everted as in adult tape-worms ; this is so even in the young individuals of our species. Moreover, the excretory system in *Piestocystis lialis* and other species is open posteriorly, while in the parasite in question it is closed in all stages of its life-history. Also in *Piestocystis lialis* the buds are produced directly by a proliferation of the internal wall of the cyst. This is a typical larval condition, but in this worm which certainly appears to be an adult, the young are developed by a typical method of parthenogenesis (Lipospermia) in the body of the worm and not form the wall of the cyst.

For the above reasons we have to conclude that the parasite is an adult cestode, though the following facts might be urged against this assumption, *viz.*, (*a*) Absence of sexual genital organs, both male and female ; (*b*) the encysted condition of the adult parasite ; but the young parasites, as has been mentioned before, find their way out of the parent cyst, after they have grown to a fair size. They then lie in the mesentery for some time before themselves becoming encysted and repeating the same life-history ; (*c*) the entire absence of the nervous and water-vascular systems. The absence of these characters, however, in no way interferes with the acceptance of the form as a Cestode parasite, which is highly degenerate—a condition which perhaps is to be correlated with a changed life-history, completed in one host only, as appears to be the case with the form in question. This is further borne out by the extensive infection of the host which results in a very large progeny.

(3) If an adult, then is it a primitive or a degenerate form ?

We cannot consider the parasite to be a simple primitive form because of its structure, particularly the structure and disposition of the suckers, the excretory vessel, the specialised cyst, and the parthenogenetic method of reproduction.

Systematic position:—Owing to the degenerate nature, and the peculiar reproductive phase of the parasite in question, there is very great difficulty in assigning it to its true position amongst the Cestoda, but the presence of four unarmed suckers, as well as an unarmed rostellum, would suggest affinities with the Taeneoidea (Cyclophyllidea). For this peculiar worm we propose the name *Ilisha parthenogenetica*, n. g., n. sp.

The generic characters would be as follows :—

Small parasitic leaf-like worms occurring in cylindrical cysts. Anteriorly there is a rostellum and four suckers, which latter are arranged symmetrically round the base of the rostellum. All these are unarmed. Sexual organs and genital pores absent. Parthenogenetic development. The young are quite like the adult and find their way out of the parent, and later on repeat the same life-history.

Of doubtful affinity.

Habitat.—The mesentery and liver of *Hilsa ilisha* (Ham. Buch.) from various places in Bengal ; September and October, 1917.

A very large number of specimens. No. Z.E.V. $\frac{7249}{7}$ in the collection of the Indian Museum.

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EXPLANATION OF PLATE IV.

FIG. 1.—*Rhynchobothrius ilisha*, n. sp. Whole worm.

,, 2.—Head of the same showing its internal anatomy.

,, 2 (*a*)—(*e*).—Various types of hooks found on the proboscides of *R. ilisha*.

,, 3.—Two proglottids of the same showing the excretory, water vascular and nervous systems.

,, 4.—Anatomy of a proglottid of the same.

,, 5.—Cyst of *R. ilisha* from the lateral muscles of Hilsa.

,, 6.—Young of *R. ilisha* dissected out of the cyst.

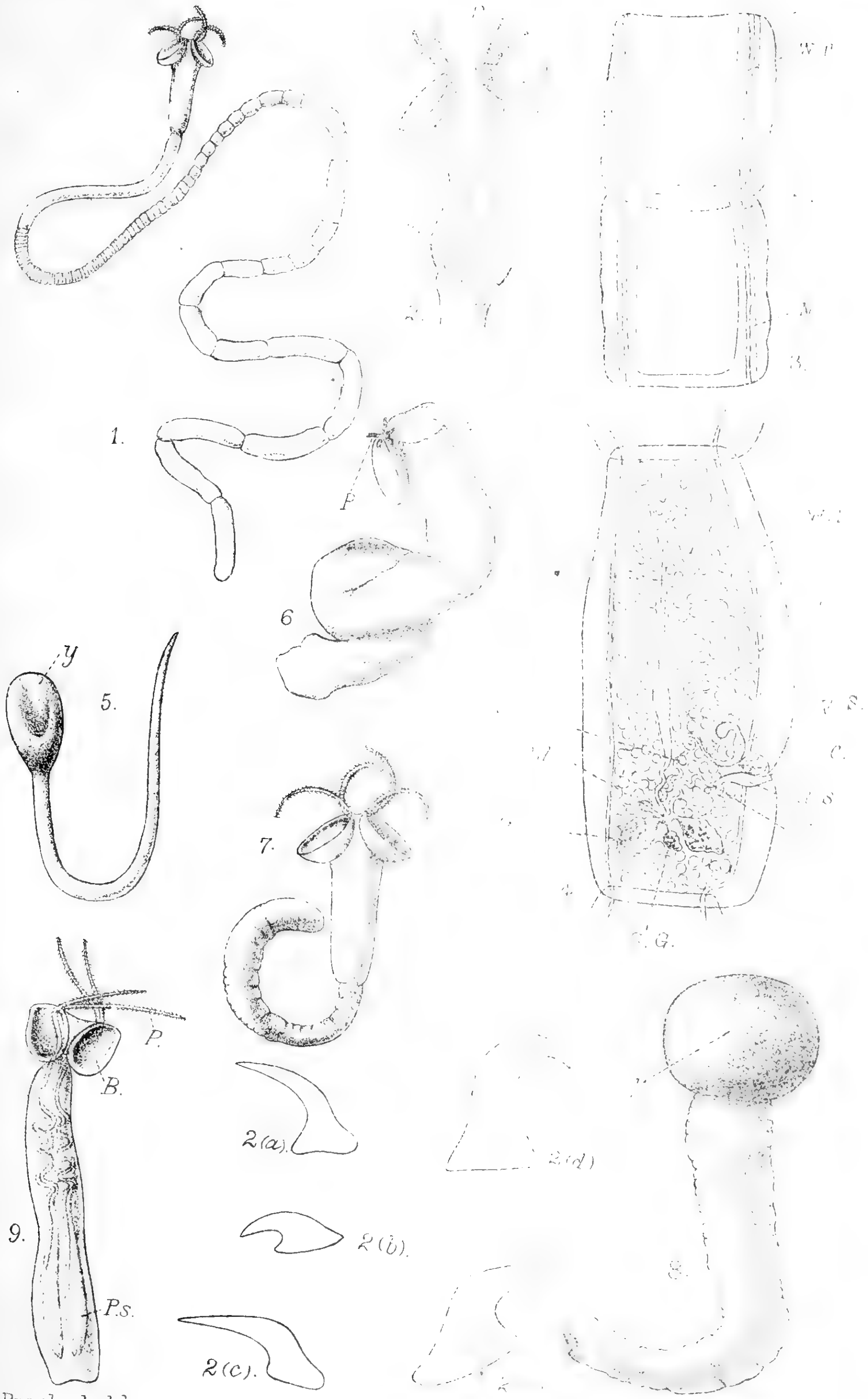
,, 7.—Young individual of *R. ilisha* from the stomach of the shark.

,, 8.—Cyst of *Syndesmobothrium filicolle* from the lateral muscles of Hilsa.

,, 9.—Young of *S. filicolle* dissected out of the cyst with the anatomy.

REFERENCE LETTERING.

B., Bothridium. *C.*, Cirrus-sac. *E.D.*, Excretory duct. *N.*, Nerve cord. *O.d.*, Oviduct. *Ov.*, Ovary. *P.*, Proboscid. *P.S.*, Proboscis sac. *R.S.*, Receptaculum seminis. *S.G.*, Shell gland. *T.*, Testis. *Ut.*, Uterus. *V.*, Vagina. *V.D.*, Vas deferens *V.S.*, Vesicula seminalis. *W.T.*, Water-vascular tube. *Y.*, Larva in the Cyst.



B. Prashad, del. & D. Bagchi.

CESTODE PARASITES OF HILSA.

EXPLANATION OF PLATE V.

FIG. 1.—Lateral view of a dissected female Hilsa to show the infected mesentery and liver, and the other viscera. The heart and ovary of the left side are removed.

,, 2.—A cyst of *Ilisha parthenogenetica* n. g., n. sp.

,, 3.—An adult individual of *I. parthenogenetica* dissected out of the cyst.

,, 4.—Surface view of the rostellum and the four suckers on the anterior extremity of an individual of *I. parthenogenetica.*

,, 5.—Parthenogenetic eggs of *I. parthenogenetica.*

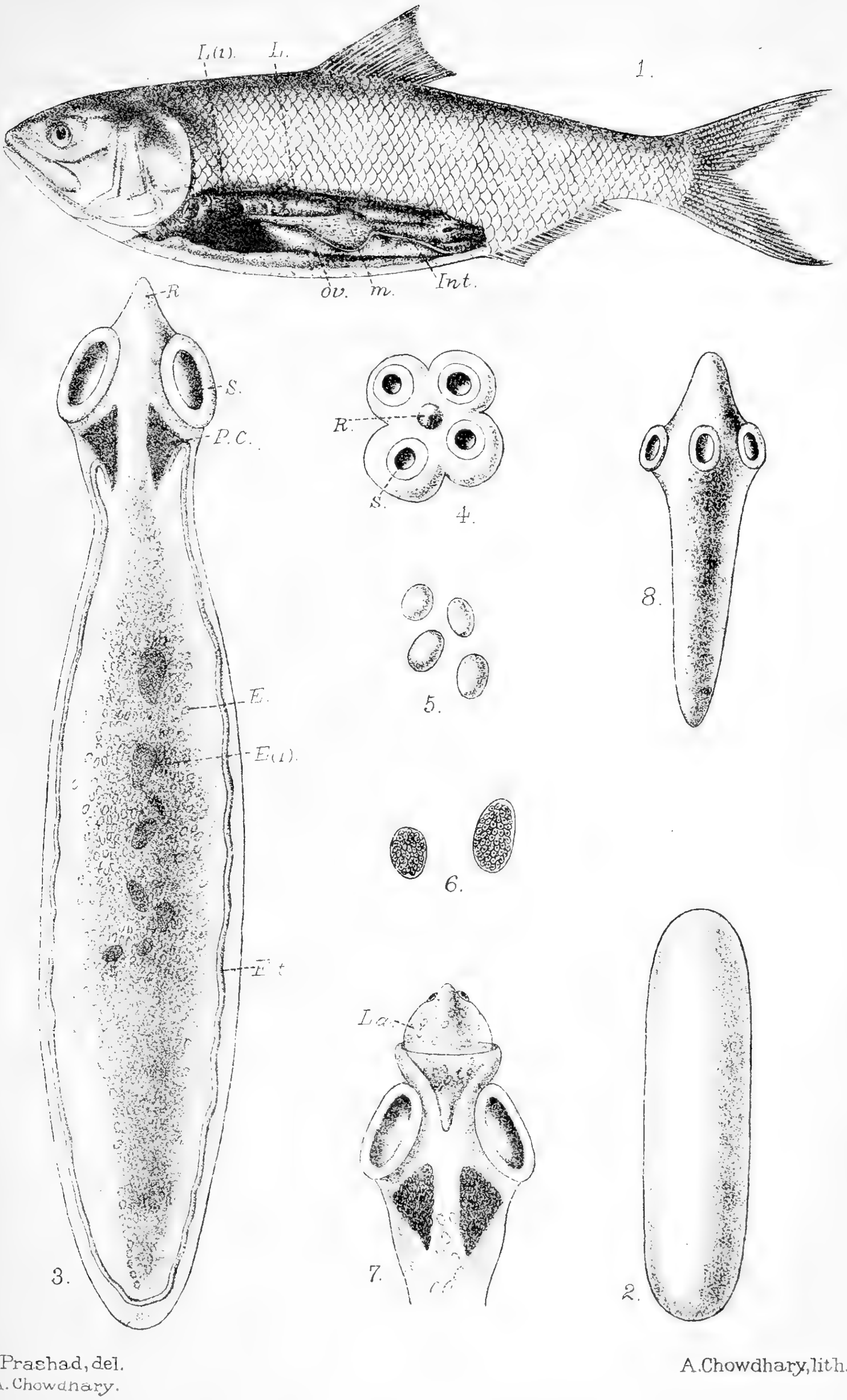
,, 6.—Morula stages in the development of the parthenogenetic eggs of *I. parthenogenetica.*

,, 7.—Anterior extremity of an adult individual of *I. parthenogenetica* with a young one escaping out of it.

,, 8.—A young individual of *I. parthenogenetica* lying free in the mesentery of Hilsa, before the formation of the cyst.

REFERENCE LETTERING.

E., Eggs. *E(i).*, Morula stage in the development of eggs. *E.t.*, Excretory tube. *Int.*, Intestine. *L.*, Liver. *L(i)*, Part of the liver infected with cysts of *I. parthenogenetica.* *La.*, Larva escaping out of the mother individual. *M.*, Mesentery infected with *I. parthenogenetica.* *Ov.*, Ovary. *P.C.*, Pigment corpuscles. *R.*, Rostellum. *S.*, *Sucker.*



B. Prashad, del. & A. Chowdhary.

A. Chowdhary, lith.

CESTODE PARASITES OF HILSA.

X. NOTES ON SOME HARES IN THE INDIAN MUSEUM WITH DESCRIPTIONS OF TWO NEW FORMS.

By C. Boden Kloss, *F.Z.S.*

I owe to the authorities of the Indian Museum the opportunity of examining a number of the hares in their collection and while studying the material lent me have put together the following notes. Unfortunately many of the skins are old and deteriorated and in some instances the skulls are very imperfect so that many features are obscured : but on the other hand little detailed information seems to have been published about the hares of the Indian Empire and many of the older descriptions are very sketchy according to modern ideas.

Though I think but little weight can be attached to the form of the cement groove, or enamel folding, of the upper incisors except for broad distinctions I have described and figured all the examples in the present series. Forsyth-Major states :—" Specimens of the same species may vary slightly owing partly to individual variation. But the shape of the enamel fold varies equally at different stages in the age of the animal ; species whose incisors show the most complicated pattern in the adult have as yet no trace of this in very young animals ; and *vice versâ* in very old specimens complication tends to disappear again." (*Trans. Linn. Soc. Zoology*, 2nd Ser., VII, p. 466 ; 1899.)

The examination of a sufficient series from one place (which is required in order to show what the degree of variation is) still remains to be made, but judging from a set in my possession of *Lepus siamensis*, Bonhote, obtained from localities in North, Central, Eastern and South-Western Siam,—even after making allowance for age—species or races seem to have an incisor groove only definable within wide limits : *L. siamensis*, for instance, possesses a furcate groove but the number and shape of the branches are very variable.

As regards hares of the Indian Empire those with some form of triangular groove only occur just within northern limits and the branched-grooved group includes the majority of its forms ; for though in one or two of those examined the groove is squarish, in them the branches have probably aborted. The present series does not show any gradation or connection between the furcate and triangular forms of groove and these two patterns seem of value for grouping purposes.

It has seemed most convenient to deal with the material geographically beginning with the north-western races. Two new forms are described.

Lepus yarkandensis.

Günther, *Ann. Mag. Nat. Hist.* (4), XVI, p. 229 (1875).

No. 3782. Sub-adult skull from Katti-ilik, Fyzabad, Eastern Turkestan (F. Stoliczka coll.). Upper incisors with the grooves triangular

in section and well filled with cement (fig. 1): very like those of "*Lepus yarkandensis ?*" from Koko Nor figured by Forsyth-Major (*Trans. Linn. Soc., Zool.*, 2nd Ser., Vol. VII, p. 468, fig. vii; 1899); and another specimen from Eastern Turkestan figured by Lyon (*Smithsonian Miscellaneous Collections*, Vol. XLV, p. 351, fig. 8; 1904).

Lepus craspedotis.

Blanford, *Eastern Persia*, II, p. 80, pl. viii.

No. 1322a. Nearly adult female (skin and skull) from Pishin, Baluchistan (W. T. Blanford coll.). Type of *L. craspedotis.*

Pelage very soft, apparently greyish-buff speckled with blackish, the rump greyest; a pale area about the eye; nape fulvous. Forelimbs brighter and more ochraceous than the body; hind-feet whitish or buffy white above, ochraceous below. Tail clear black above, ungrizzled. Underparts white except the foreneck which is fulvous; lower abdomen clad with long hair. Ears apparently very large with a long fringe of hair along their upper edge. Groove in upper incisors in shape a rather acute isosceles triangle about half filled with cement (fig. 2).

The skulls of this animal and of *L. yarkandensis* (No. 3782 *antea*) differ from all the following in the relative narrowness of their palatal bridges and in the large size of their bullae, those of *L. yarkandensis* being very big indeed, round and dilated; of *L. craspedotis* rather longer though not so broad but with even larger external auditory meatus: *craspedotis* has also rather larger palatal foramina and the anterior "foot" of the zygomatic arch is hardly expanded at all, while in *yarkandensis* the foot is smaller than in any of the following specimens.

Both have the nasals truncate posteriorly, those of *craspedotis* being quite square-ended, also its post-orbital processes are much larger, broader, and almost touch the frontals behind—often they probably do as there are distinctly rough-tipped projections on the latter bones which seem to indicate complete contact: in both species the processes are relatively larger than in any of the following.

Lepus dayanus.

Blanford, *Proc. Zool. Soc.*, 1874, p. 663.

No. 1293b. Adult skin and skull from Nara-Nai Hills, west of Sehwan on the Indus, Sind (W. T. Blanford coll.).

Pelage harsher than *craspedotis* but not so harsh as in the following species: apparently agreeing with the description of the types of *dayanus* which came from Sukkur on the Indus, about 100 miles N. N. E. of Sehwan. Hairs of upper side of tail with dark bases almost concealed by fulvous tips.

The specimen is apparently a female as the lower abdomen is clad with very long hair.

Upper incisors with cement-grooves completely filled and almost square in section but the posterior border and the sides slightly concave and the corners rounded (fig. 3), less elongate than those of the cotype

figured by Forsyth-Major (*l. c. s.*, fig. xviii) and not so forked posteriorly.

The skull has considerably smaller bullae but larger palatal foramina than *yarkandensis* and *craspedotis*, with the palatal bridge a trifle broader: the inter-orbital width is greater ; there is a well-developed anterior foot to the zygomata ; the nasals are rounded posteriorly towards their outer sides and the post-orbital processes are joined to the frontals behind.

Lepus cutchensis, sp. nov.

No. 9827. *Type.*—Nearly adult male (skin and skull) from Bhuj, Kutch, collected on 17th August 1911 by the Bombay Natural History Society's Mammal Survey. Original No. 401.

Characters.—Pelage very like that of *L. dayanus* from Sehwan but perhaps a little harsher; tail darker and less grizzled : bullae smaller. Skull like that of *ruficaudatus* in the broad sense, but pelage duller and tail dark.

Colour.—Upper parts a grizzle of pale buffy and dark brown, the former predominating, but distinctly greyish above the base of the tail. Limbs and top of muzzle ochraceous-buff, the hind feet rather paler above. Sides of muzzle and area about the eyes whitish ; nape and foreneck nearly avellaneous-buff, not blackened. Throat, underside of body and tail and inner sides of thighs white. Hair beneath the digits of all limbs tawny. Ears finely grizzled buff and brown and edged with buff, the lower edge paler ; the tips blackish posteriorly ; the bases whitish below. Tail bone-brown above, slightly grizzled with ochraceous-buff.

Skull and Teeth.—Skull very like that of *ruficaudatus* (s. g.), having smaller bullae than *dayanus*, as small or smaller than *ruficaudatus* : palatal bridge broader but palatal foramina narrower than in *dayanus*, zygomatic feet equally developed ; nasals similarly rounded posteriorly; inter-orbital breadth less ; post-orbital processes considerably smaller and short, showing no sign of posterior contact with the frontals.

The grooves of the incisors, though of the same bifurcate pattern as in the cotype of *dayanus* figured by Forsyth-Major (*l. c. s.*, fig. xviii), have the branches longer and more distinct and more divergent ; they are completely filled with cement (fig. 4).

Measurements.—Collector's external measurements :—Head and body, 415 ; tail, 80 ; hind foot, 101 ; ear, 93. For other measurements see table, p. 96.

Lepus ruficaudatus.

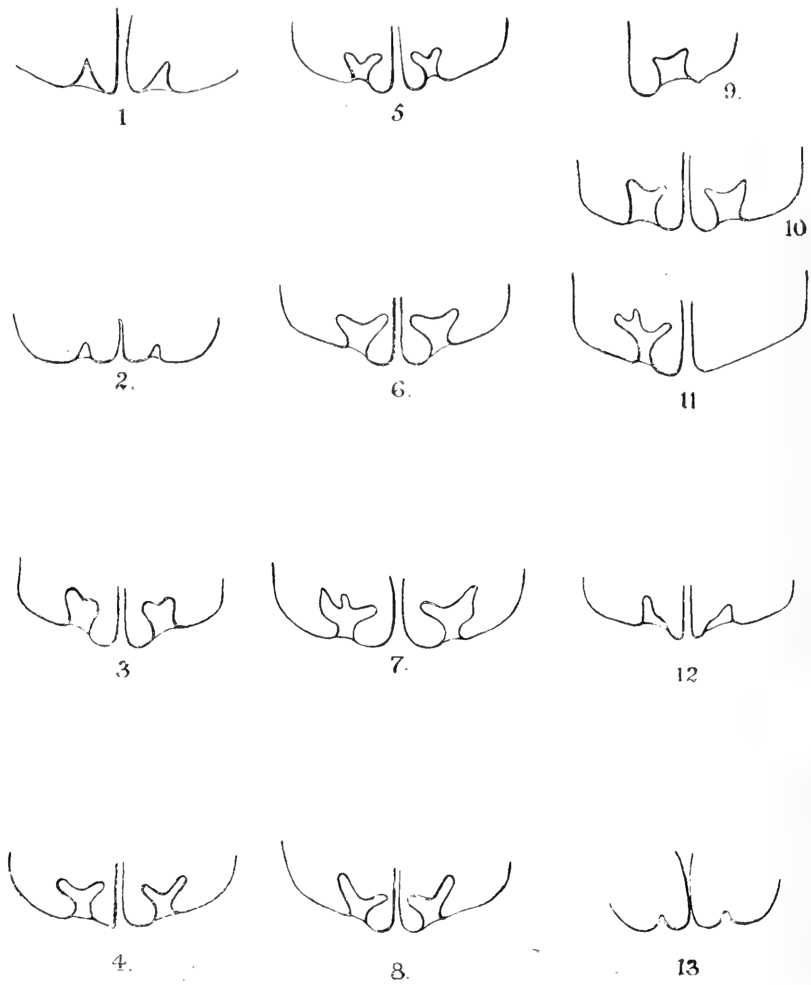
Geoffroy, *Dict. Class. Hist. Nat.*, IX, p. 381 (1826).
Lepus macrotus, Hodgson, *Journ. Asiat. Soc. Bengal*, IX, p. 1183 (1840) (Gangetic Plains and sub-Himalayas).

No. 10172. Adult skin and imperfect skull from Thankot, Nepal (J. Scully coll.).

Apparently a brightly coloured animal, ochraceous and black above, the lower portions of the limbs ochraceous to ochraceous-tawny throughout : the upper surface of the tail ochraceous, some of the

hairs tipped with black but all without dark bases. A pale patch in front of and about the eye. Ears apparently rather small.

The incisor grooves are of the same general form as No. 9827 (*L. cutchensis*); the principal difference being that the posterior edge is



Anterior end of upper Leporine incisors from below.
(Enlarged: not to scale.)

Fig. 1	*Lepus*	*yarkandensis.*		Figs. 5-10.	*Lepus*	*ruficaudatus.*	
,, 2.	,,	*craspedotis.*	Type.	Fig. 11.	,,	*peguensis.*	Type.
,, 3.	,,	*dayanus*		,, 12.	,,	*sadiya*	Type.
,, 4	,,	*cutchensis.*	Type.	,, 13.	,,	*sinensis*	

sharply angular instead of regularly curved: the inner side of the tooth projects forward considerably so that the groove appears to be not fully filled with cement (fig. 5): the molars are small.

Nasals short, irregularly rounded posteriorly, inter-orbital breadth small, palatal bridge of medium width.

The skull, though fully adult,[1] indicates an animal so much smaller than the last and following that, if typical, it might be regarded as subspecifically distinct in which case Hodgson's name *aryabertensis* would apply (*Calcutta Journal of Natural History*, IV, p. 293—Nepal).

No. 10327a. Old mounted male from Agra District much faded and worn.

Tail ochraceous above throughout.

Upper incisors large, the groove bifurcating fairly regularly, the posterior edge concave, branches of medium length, stem moderately broad (fig. 6).

No. 7244. Adult skin and skull from Gaya District, Bihar (F. Field coll.).

Colour less bright than the Nepal specimen, back and sides approaching buff; a considerable amount of whitish on the sides of the head; both sides of the hind feet also pale. Hairs of the upper side of tail ochraceous distally, dark brown basally.

Skull large, nasals somewhat rounded posteriorly, post-orbital processes of medium size and not touching the frontals behind: palatal foramina large and palate bridge broad, anterior feet of zygomata very large (12·5 mm. long).

Incisor grooves showing greater development than the last: the stem is narrower in proportion to the spread of the branches of which the right incisor exhibits two and the left three, the extra branch being median and small (fig. 7).

No. 10174b. Skin from Manbhum, Bengal (R. C. Beavan coll.).

In every way as brightly coloured as the Nepal specimen with the hairs of the upper side of the tail ochraceous throughout except for some dark tips. The hair below the digits is dark tawny, in marked contrast to the ochraceous limbs; but this feature is probably fortuitous.

No. 10328a. Skin from Manbhum, Bengal (R. C. Beavan coll.). As the last except that the hair beneath the digits is not dark.

No. 7317. Portion of skin with perfect skull from Calcutta.

The fragmentary skin indicates an animal nearly as bright as the Manbhum individuals.

Skull with nasals pointed posteriorly, and rather small post-orbital processes not approaching the frontals. Palatal bridge narrow with a posterior median spine, mesopterygoid space broad, bullae like the last but more globose; molars small.

Incisor grooves bifurcating with well developed branches completely filled with cement (fig. 8): Very like those of a specimen from the Jumna River figured by Lyon (*l. c. s.*, fig. 10) but branches more elongate.

Lepus ruficaudatus seems to be a species in which the incisor grooves are normally bifurcate but also develop three and four branches as in the animals from the Punjab and Rajputana figured by Forsyth-Major (*l. c. s.*, figs. xxiii and xxiv): for Punjab material the name *kurgosa* has apparently been proposed by Gray.

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[1] Specimens are here regarded as fully adult when the frontal suture is largely obliterated: otherwise they are called nearly adult or sub-adult.

No. 10004. Adult skin and imperfect skull from Satpara, Puri District, Orissa (S. W. Kemp coll.).

Colour not markedly differing from the Gaya example (No. 7244) with muzzle and top of head ochraceous but the sides of the head and hind feet less white. Hairs of upper side of tail ochraceous distally, greyish-brown basally.

Skull large with the nasals broadly rounded posteriorly, palatal bridge narrower than in No. 7244.

The groove of the right incisor (left missing) well filled with cement, of simple form almost square in section, the posterior angles projecting very slightly (fig. 9).

No. 10173. Nearly adult skin and imperfect skull from the Naga Hills, Assam (A. W. Chennel coll.).

Colour like the last but a little less bright. A ring round the eye buffy instead of whitish : hairs of upper side of tail without dark bases.

A smaller skull than the last with the nasals narrower posteriorly, frontals much narrower and narrower palatal bridge.

Incisor grooves of essentially the same type but their posterior angles sharper and more projecting (fig. 10).

The difference between this individual and the last does not appear to be great and the incisor grooves are similar. If the latter were typical Tytler's name *tytleri* (*Ann. Mag. Nat. Hist.* (2), XIV, p. 176; 1854) based on material from Dacca, an intermediate locality, might possibly apply. But the presence of the above recorded specimen No. 7317 from Calcutta (fig. 8), also an intermediate locality, renders such a course impossible until more is known of the hares ranging from the Bengal Coast to Assam. It is of course highly probable that the Calcutta specimen was obtained in the Bazaar and came from up-country.

Lepus peguensis.

Blyth, *Journ. Asiatic Soc. Bengal*, XXIV, p. 471 (1855).

No. 435a. Mounted skin and imperfect skull (scarcely fully adult) from Upper Pegu (Sir A. Phayre coll.). Type of *L. peguensis*.[1]

The skin has suffered much from exposure but exhibits clearly the white upper surfaces of the hind metapodials and small pale patches on the forefeet; and also the pure dark upper surface of the tail (now altered to "seal brown").

Nasals pointed posteriorly, frontals broad, post-orbital processes not touching behind ; palatal foramina broad, palate bridge medium.

Groove of left incisor (right damaged) very similar to those figured by Forsyth-Major (*l. c. s.*, fig. xx), consisting essentially of a two-branched groove with the outer branch bifurcating and the stem fairly narrow : well filled with cement (fig. 11).

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[1] The first example of *L. peguensis* seen by Blyth and recorded as identical with *sinensis* Gray (Journ. Asiat. Soc. Bengal, XXI, 1852, p. 359) was a hare from Arakan : it was evidently not made the type of the species for its ears had been destroyed whereas in the present specimen they are perfect, and there is no black on the underside of the paws as was stated to be the case with the first animal.

Lepus sadiya, sp. nov.

Lepus sp., Robinson, *Rec. Ind. Mus.*, VIII, p. 90 (1913).

No. 9165. *Type.*—Adult skin and skull from Kobo about 15 miles west of Sadiya, N.-E. Assam. Collected during the course of the Abor Expedition by Mr. S. W. Kemp.

Characters.—Pelage somewhat as in *L. peguensis* Blyth, with metapodials of hind feet whitish, but colour generally paler and duller, and tail suffused with ochraceous. Grooves of incisors roughly triangular.

Colour.—Upper parts mingled buff and black, top of face tinged with ochraceous, sides of head rather paler buff, some white on the sides of muzzle and areas round eyes, sides of body buffy-white with a few black tips to the hairs. Nape ochraceous-tawny slightly grizzled with black. Fore-limbs ochraceous-buff; forefeet dull buff above with a few white hairs above the claws, below greyish-buff; hind feet white above with some buff hairs over the digits, below and at sides greyish-buff. Tail above superficially ochraceous but the hairs with dark brown bases ("seal brown") most visible near the tip: throat, under parts of body, back of fore-limbs, front and inner aspect of hind-limbs and under-surface of tail white, gradually blending on the under-body with the colour of the sides. Extremity of chin grey; fore-neck like the fore-limbs, the hairs faintly tipped with black. Ears finely grizzled blackish and buff, the former in excess; the edges fringed with buff except the tip externally which is brownish-black.

Skull and Teeth.—Skull rather smaller than the type of *peguensis*, the posterior termination of the nasals rounded; frontals narrower and post-orbital processes larger, not, however, touching the skull behind. Palatal foramina relatively narrower, palate bridge broader with a pronounced posterior spine, mesopterygoid space very narrow; anterior feet of zygomata moderate; bullae about as in *ruficaudatus* (they are missing in the type of *peguensis*).

Incisor grooves triangular (thus approximating towards *sinensis*, Gray) but well filled with cement and the inner borders slightly sinuate; inner side of incisor very narrow and projecting considerably (fig. 12).

Measurements.—See table, p. 96.

Remarks.—I have no skins of *Lepus sinensis* or other Chinese hares to compare this animal with, but judging from descriptions it is quite distinct. While the shape of the incisor groove shows that it is allied to the northern animals the white hind-feet connect it with *peguensis*.

Lepus sinensis.

Gray, *Ill. Ind. Zool.*, II, pl. xx (1834).

No. 436c. Imperfect skull of young adult from Amoy, South China.

Skull small, rostrum slender, nasals obliquely truncate, frontals broad, post-orbital constriction narrow; palatal bridge relatively broad and mesopterygoid space wide.

Incisor grooves triangular much as figured by Forsyth-Major (*l. c. s.*, fig. vii) but with less cement therein, the groove being practically empty except at the extreme apex (fig. 13).

No.	Name.	Hind-foot. s. w.*	SKULL. Greatest length.	Basilar length.†	Dias-tema.†	Upper molar row (alveoli).	Palatal bridge, least breadth.	Mesop-terygoid space, least breadth.	Diagonal length of nasals.	Anterior frontal constric-tion.	Posterior frontal constric-tion.	Zygomatic breadth.	
3782	*Lepus yarkandensis*, Gthr. . .	..	78·0	61·0	22·0	14·0	5·2	7·2	39·3	16·0	14·0	37·0	Sub-ad.
1322*a*	,, *crassedotis*, Blanf. . Type	106	80·0	61·2	23·0	15·0	5·0	7·0	31·0	15·5	11·0	39·0	Sub-ad.
1293*b*	,, *dayanus*, Blanf. . .	95	84·0	66·0	24·8	15·1	5·8	6·8	36·6	18·0	12·2	36·6	Ad.
9827	,, *cutchensis*, mihi. . Type	101	86·2	66·5	23·0	16·1	7·0	6·6	38·8	15·5	12·1	38·2	Sub-ad.
10171	,, *ruficaudatus*, Geoffr. .	90	..	60·0	22·8	14·0	6·2	6·1	..	16·0	12·1	38·2	Ad.
7244	,, ,, ,, . .	101	92·0	73·0	28·0	17·0	8·0	7·5	44·0	19·3	13·8	41·5	Sub-ad.
7317	,, ,, ,, . .	..	88·8	68·0	26·0	15·7	5·0	8·1	40·0	17·2	12·0	40·8	Ad.
10004	,, ,, ,, . .	..	..	69·5	27·1	16·0	6·7	7·4	40·2	19·0	..	± 39·5	Ad.
10173	,, ,, ,, .	103	..	..	24·5	15·0	5·5	5·8	..	15·7	13·7	39·0	Sub-ad.
435*a*	,, *pequensis*, Blyth . Type	100	89·0	..	27·0	16·3	7·0	6·7	42·5	17·5	14·8	..	Sub-ad.
9165	,, *sadiya*, mihi. . . Type	88	83·0	65·0	24·0	16·4	7·1	4·9	40·5	15·3	12·0	37·7	Ad.
436*c*	,, *sinensis*, Gray	..	..	..	22·1	16·0	6·2	6·7	39·2	17·2	11·8	37·7	Sub-ad.

* From dried skin.
† From back of large incisor.

XI. THE MIDDLE EAR OF INDIAN FROGS.

By BAINI PRASHAD, *M.Sc.*

(With Plate IX.)

On each side of the head of the common frog the skin in the middle of the temporal patch is distinguished as the tympanic membrane or tympanum. The description of this structure in *Rana temporaria* may be given in the words of Marshall (13) : " Behind the eye on either side is an obliquely placed elongated patch of a dark colour, in the middle of which is a circular area—the tympanic membrane—supported by a marginal ring." Other text books of Zoology in their accounts of *R. temporaria* describe the condition in the same way as Marshall, while some say that the tympanic membrane is close to the surface and only covered over with skin.

Claus-Sedgwick (5) in the general account of the amphibia try to get over the difficulty in the following way : " In the Batrachians alone there is a tympanic cavity .... which is closed externally by a tympanic membrane, which is sometimes freely exposed on the surface and sometimes covered by the skin." Boulenger (2—4) in his systematic works describes the tympanum as distinct, indistinct or hidden under the skin, according as the area of skin is marked off from the surrounding skin or otherwise. Hoffman (12) is not definite as to whether the tympanum is a structure distinct from the skin covering it. Cope (6) states that there is a dermal membrana tympani connected with the stapes through a chain of ossicula auditis ; evidently he considers the tympanum to be a distinct structure from the skin covering it, though he does not definitely say so. Crombie (7) deals with the function and tension of the membrana tympani of the mammals only. Fox (8) in his paper on the development of the tympano-eustachian passage of the common American toad deals with the development of the tympanic cavity, the eustachian tubes and the ossicula auditis, but says nothing about the tympanum. Villy's admirable paper (16) on the development of the ear of the European frog does not contain any reference as to the development of this structure or its relations with the skin. Hasse in his two papers (10, 11) deals with the structure of the internal ear of the frog only. Norris (14) does not try to clear the problem. Retzius (15) is the only author who has definitely stated that there is a distinct tympanic membrane underlying the skin. Haslam in his translation of Ecker's " Anatomy of the Frog " (9) has rewritten the whole section on the ear from Retzius' paper cited above.

From the review of literature on the subject it will be clear that a great deal of confusion exists regarding the tympanum being a structure distinct from the skin or otherwise. It was with a view to do something

towards the solution of this problem that the present work was undertaken.

MATERIAL AND METHODS.

I have investigated in detail the structure of the middle ear of the large Indian frog *Rana tigrina*, Daud.[1] There are several forms closely allied to this frog in India, but the form common in Lahore where the work was done is the typical one, as was ascertained by sending some specimens to Dr. Boulenger in London. Besides a large number of dissections of this frog I cut sections of decalcified specimens of both young and adult frogs; these sections were found to be very useful in clearing up the doubtful points and indicating the exact relationships of the various parts.

Through the kindness of Dr. N. Annandale, Director of the Zoological Survey of India, Calcutta, I was able to examine the large collections of frogs in the Indian Museum, Calcutta, and so am able to add an account of the structure as it occurs in a large number of other Indian frogs. I am also deeply indebted to Lt.-Col. J. Stephenson, D. Sc., I.M.S., Professor of Zoology and Principal, Government College, Lahore, for kindly giving me leave to go to Calcutta to work in the Indian Museum, and for sanctioning a special grant towards the expenses.

Rana tigrina.

The structure of the middle ear in this frog will be described in the following order :—

(1) The tympanic area.
(2) The tympanic membrane.
(3) The tympanic cavity and associated skeletal structures.

The Tympanic area (fig. 1).—I have reluctantly changed the widely accepted nomenclature in order to remove the existing confusion, and have given the name of *tympanic area* (*T. a.*) to the area of skin situated in the temporal patch on the side of the head. This area is continuous with the skin, but is tightly stretched over the marginal ring of the annulus tympanicus, and is slightly more depressed than the skin all round it. It is nearly circular in outline and is a little smaller than the eye. About the middle of this structure the attachment of the columella auris can be seen as a nodular protrusion.

The histological structure of this portion of the skin is quite simiiar to that of other parts of the skin, except that the number of cutaneous glands is much smaller; about the middle no cutaneous glands are to be seen (*text fig. 1*).

The Tympanic membrane (figs. 2, 3, and 4).—This is quite a distinct structure lying immediately underneath the so-called tympanic membrane of authors. It can be easily separated from the skin covering it. On the skin being reflexed by a cut, the tympanic membrane (*T. m.*) is seen to be of a rounded-oval form slightly notched at the upper side, and produced into a little projection on its lower.

[1] I have satisfied myself by examination of specimens of *R. esculenta* and *R. temporaria* that the structure in these frogs is also essentially similar to that of *R. tigrina*.

It is attached all along the circumference to the slightly up and inturned edges of the annulus tympanicus. The tympanic membrane is thin along the margin but is specially thickened in the middle on its inner side for the attachment of the distal end of the columella auris.

The membrane is formed of connective tissue fibres which radiate from the central point of attachment of the columella to the periphery. A few blood vessels, nerve cells and a large number of pigment corpuscles are also found scattered in the connective tissue. Along the margin some unstriated muscle fibres are also to be seen. Internally the tympanic membrane is lined by columnar epithelium (*text fig. 2*) which is continuous lower down with the mucous membrane lining of the tympanic cavity.

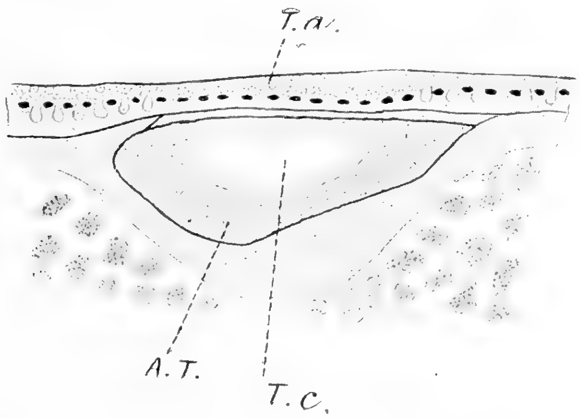

FIG. 1.—Transverse section of the ear of *R. tigrina.*

The Tympanic cavity and associated skeletal structures.—After the removal of the tympanic membrane the tympanic cavity is seen to be a funnel-shaped structure. The upper margin of the funnel is slightly turned inwards for the attachment of the tympanic membrane as seen in a transverse section (*text fig. 1*). The funnel-shaped tympanic cavity has its longer axis directed downwards and backwards from the anterior and upper side. This upper or outer portion of the tympanic cavity is formed by the annulus tympanicus (*A. T.*); from the lower end of the annulus tympanicus the tympanic cavity becomes very much reduced and continues as a slightly depressed tubular structure, the cross section of it hence is not circular but slightly elongated. The beginning of this second or inner portion of the tympanic cavity may be termed the *tympanic recess* (*T. r.*), while the opening by which it communicates with the internal ear is known as the *fenestra ovalis* (fig. 4, *f. o.*). From the ventral surface of this deeper portion of the tympanic cavity a short wide eustachian tube puts the tympanic cavity of each side into communication with the pharyngo-oral cavity. The deeper portion of the tympanic cavity is bounded by the squamosal and prootic bones anteriorly, by the prootic dorsally, by the cartilaginous portion between the prootics and exoccipitals internally and by muscles posteriorly.

The tympanic cavity is lined all along by mucous membrane which is very vascular and pigmented.

The annulus tympanicus (figs. 4, 5, *A. T.*) is a cartilaginous framework of the shape of a short truncated cone, broad outwards and narrowing towards the inner side. The frame is not a complete structure, but is interrupted on the dorsal surface, the space between the two parts being occupied by a cartilaginous process (*a′*, Parker's *suprastapedial*) of the extrastapedial cartilage of the columella auris. The annulus tympanicus is supported on the anterior, dorsal and ventral surfaces by the squamosal bone, while posteriorly by muscles. The *columella auris* (fig. 6) has the oval outer surface of the extrastapedial cartilaginous portion (*a*) embedded in the tympanic membrane (*text fig.* 2), whilst the suprastapedial processes (*a′*) from its posterior surface

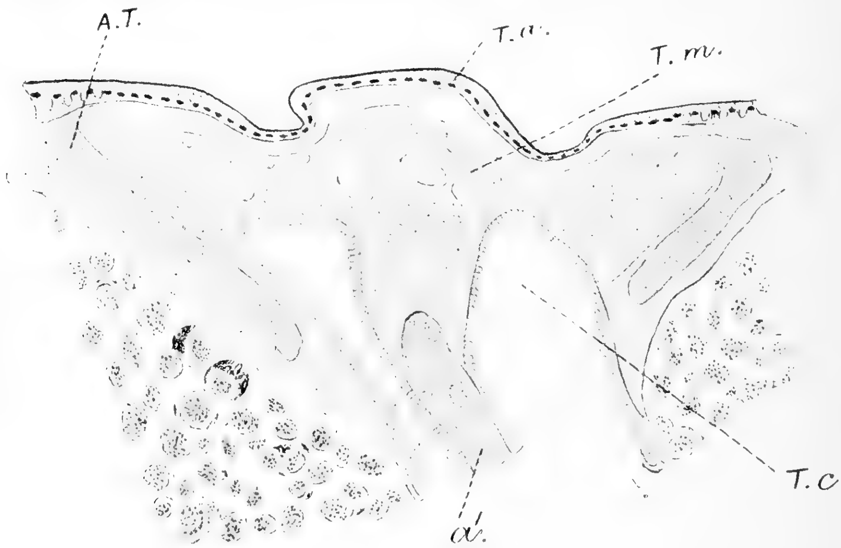

FIG. 2.—Transverse section of the ear of *R. tigrina* through the region of the columella.

goes to complete the annulus tympanicus as has been described above. The middle bony portion or the mediostapedial (*b*) after passing through the tympanic recess continues through the deeper portion of the tympanic cavity, to end in the cartilaginous interstapedial (*c*), which fits into the fenestra ovalis (fig. 4, *f. o.*).

Having described in detail the structure in *R. tigrina*, I will now describe the condition of the tympanic area of some other Indian frogs.

FIRMISTERNIA.

Family RANIDAE.—

Oxyglossus.—According to Boulenger (3) the tympanum [1] is indistinct in this genus. In specimens of *O. lima* and *O. lævis* the tympanic area is not distinctly marked off, but the attachment of the colu-

[1] The word *tympanum* used here and further on is used in the sense in which it is used by Boulenger and is equal to *tympanic area* of the suggested nomenclature.

mella is visible as a distinct nodule raising up the skin. The tympanic membrane is quite a distinct structure underneath the skin.

Rana.—The tympanum in most species is distinct, but in a few may be hidden. The condition in *R. tigrina* has been described in detail. In *R. liebigii*[1] the tympanic area is not distinct, but the tympanic membrane is seen to be quite a distinct structure lying under the skin.

Micrixalus.—The tympanum may be indistinct or hidden. In a large series of specimens of *M. silvaticus* of different ages it was seen, that the tympanic area is quite distinct in the young, becoming indistinct in older specimens, and in the fully adult it is not to be distinguished. The tympanic membrane is quite a distinct structure.

Nyctibatrachus.—The tympanum in this genus is described as hidden. In some well preserved specimens of *N. major* the tympanic area was distinctly marked off as a light-brown patch of skin; in the other poorly preserved specimens however it was not distinct.

Nannobatrachus.—The tympanum for this genus also is described as hidden. The condition in specimens of *N. beddomii* examined was the same as described for *Nyctibatrachus major*; and the distinctness of the tympanic area depended largely on the condition of preservation.

Rhacophorus.—The tympanum is usually distinct. In *R. maximus* it is distinctly depressed and is overhung on the upper side by a fold of skin, which makes the structure very prominent.

Ixalus.—The tympanum may be distinct or hidden. In the two species *I. glandulosus* and *I. leucorhinus*, examined by me it was quite distinct.

Family Engystomatidae.—This family is peculiar in having the tympanic area shifted to a much more forward position than in the Ranidae; it lies quite close to and at a much lower level than the eyes, in some it lies just below the eyes.

Calophrynus.—The tympanum is distinct. In *C. pleurostigma* tympanic area was found to be definitely marked off, and covering over the tympanic membrane lying under it.

Microhyla.—The tympanum is described as hidden. In specimens of *M. rubra* examined by me the condition (fig. 10) was the same as in *Calophrynus* described above.

Kaloula.—The tympanum according to Boulenger is hidden. In three specimens of *K. obscura*, the tympanic area was not a distinctly marked off portion, but in two better preserved specimens it was quite distinct. In *K. pulchra* (fig. 9) the tympanic area was slightly depressed and so better marked.

Cacopus.—The tympanic area in specimens of *C. systoma* is quite indistinguishable externally (fig. 7) but on removal of the skin (fig. 8) the tympanic membrane is seen to lie under the skin quite close to the eye.

Glyphoglossus.—The tympanum is described as hidden. In two well preserved specimens of *G. molosus* the tympanic area was seen as a slightly depressed circular area with raised edges, and lying just

[1] Dr. Annandale informs me that there is a very great confusion about this species, several species being confused under the name, but the form referred to is the true *R. liebigii*, Gthr.

below the eyes. The colour was the same as that of the skin covering the rest of the body.

Arcifera.

Family Bufonidae.—The conditions are essentially similar to those in the Ranidae.

Bufo.—The tympanum is distinct or hidden, seldom absent. In *B. himalyanum* (fig. 11) the tympanic area is a comparatively small structure, in some specimens it was partially covered over by the well developed parotid gland arching over it.

Cophophryne.—In *C. sikkimensis* no tympanic area is marked off externally, but on removal of the skin the tympanic membrane is seen to be quite distinct.

Family Hylidae.—

Hyla.—In *H. annectens* (fig. 12) there is a distinct tympanic area, but in some other species it is absent.

Family Pelobatidae.—Boulenger described the condition of the tympanum for the only Indian genus *Leptobrachium* (now united with *Megalophrys*) in his original account (3) as indistinct or hidden; in a later paper (4) for *Megalophrys* he says "distinct or hidden under the skin." In *M. carinense* (fig. 13) the tympanic area was seen to be quite distinct, lying very far back. The tympanic membrane was found to lie underneath it, and the annulus tympanicus was found to have shifted to a much lower position, being now supported by the vertical limb of the T shaped squamosal. This position is due to the greatly depressed condition of the head, and with it the great forward inclination of the squamosal bone.

Summary.

The structure of the middle ear of *R. tigrina* is described in detail. A change of the usually accepted names is proposed in view of the present work. The name of the so-called "tympanic membrane" has been changed to "tympanic area," because the "tympanic membrane" is a distinct structure lying underneath the tympanic area stretched over the annulus tympanicus. An account of the tympanic area as seen in a large number of Indian frogs of the various families is also given.

The condition of preservation of the specimens was often found to be responsible for the distinctness with which the tympanic area was marked off from the rest of the skin; whereas it was quite well seen in well preserved specimens, it could hardly be distinguished in poorly preserved ones.

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EXPLANATION OF PLATE IX.

FIG. 1.—*Rana tigrina*, head of an adult female specimen.

,, 2.—Head of *R. tigrina* with the skin over the tympanic membrane and the side of the head reflexed.

,, 3.—Skull of *R. tigrina* showing the attachment of the tympanic membrane, side view.

,, 4.—Skull of *R. tigrina* showing the attachment of the annulus tympanicus, the tympanic membrane and the columella auris, seen from behind.

,, 5.—Annulus tympanicus of *R. tigrina*, seen from above.

,, 6.—Columella auris of *R. tigrina*, seen from the posterior side.

,, 7.—*Cacopus systoma*, head of an adult male.

,, 8.—Head of a *Cacopus systoma* with the skin over the side of the head reflexed.

,, 9.—*Kaloula pulchra*, head of a young specimen showing the tympanic area.

,, 10.—*Microhyla rubra*, head of an adult specimen.

,, 11.—*Bufo himalyanum*, side view of the head.

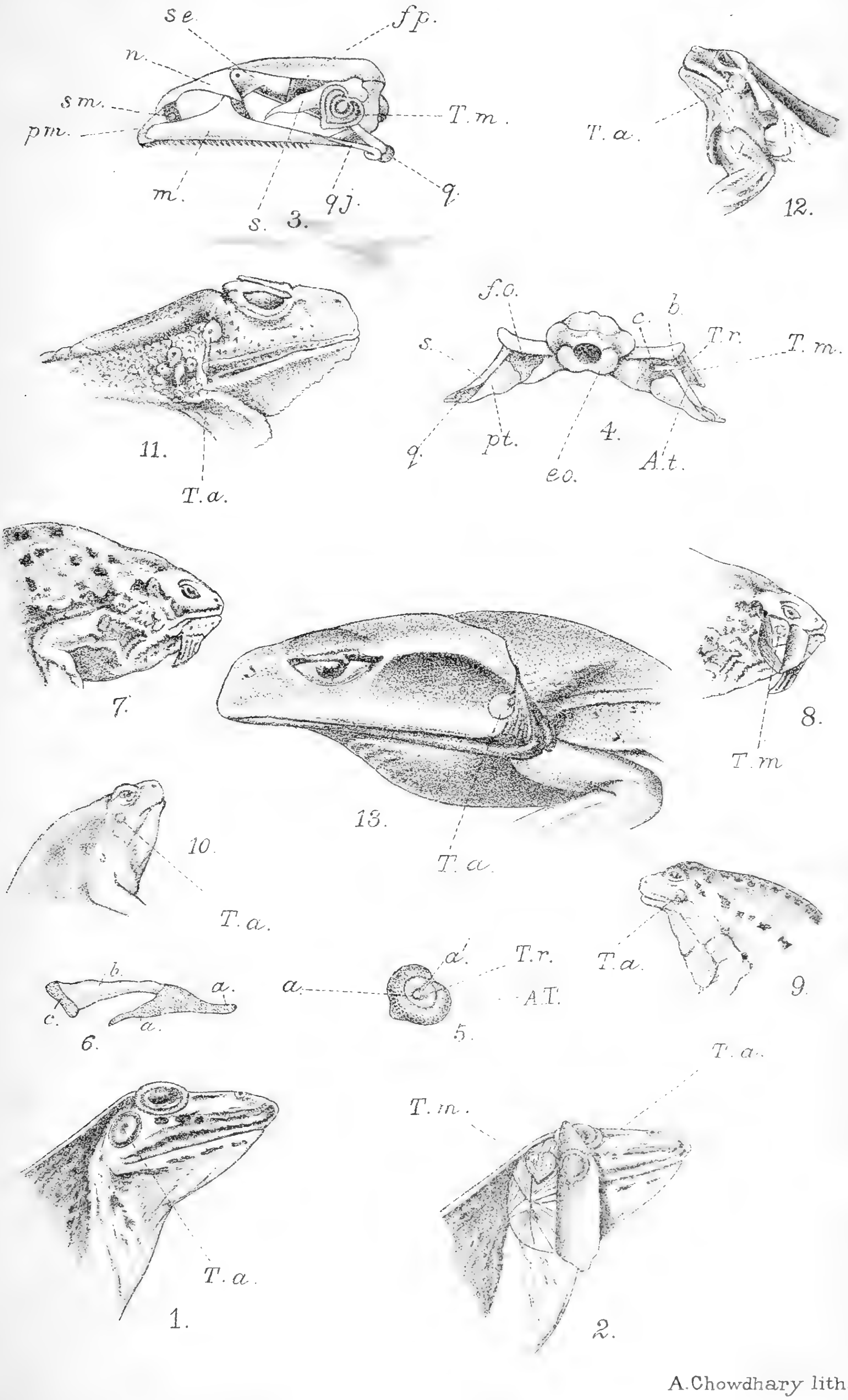
,, 12.—*Hyla annectens*, side view of the head.

,, 13.—*Megalophrys carinense*, side view of the head of an adult specimen.

REFERENCE LETTERING.

a. Extrastapedial portion of the columella. *a'*. Suprastapedial process of the extrastapedial. *A. t.* Annulus tympanicus. *b*. Mediostapedial portion of the columella. *c*. Interstapedial portion of the columella. *eo*. Exoccipital. *f. o.* Fenestra ovalis. *fp*. Frontoparietal. *m*. Maxilla. *n*. Nasal. *pm*. Premaxilla. *pt*. Pterygoid. *q*. Quadrate. *qj*. Quadratojugal. *s*. Squamosal. *se*. Sphenethmoid. *sm*. Septomaxillary. *T. a.* Tympanic area. *T. m.* Tympanic membrane. *T. r.* Tympanic recess.

Plate IX.



A. Chowdhary lith.

MIDDLE EAR OF INDIAN FROGS.

XII. A NOTE ON THE SKELETONS OF *BALAENOPTERA EDENI*, ANDERSON, IN THE INDIAN MUSEUM, CALCUTTA.

By Roy Chapman Andrews, *A.M., Associate Curator of Mammals, American Museum of Natural History, New York City.*

(With Plate XV.)

In 1871 a whale was stranded in an inlet off the Gulf of Martaban. The skull and a portion of the skeleton were recovered and deposited in the Indian Museum where they were subsequently examined by Dr. John Anderson and described by him under the name *Balaenoptera edeni*[1].

Since Dr. Anderson's paper there has been no critical study of this skeleton until my monograph[2] published in March, 1916, where it was considered in relation to *Balaenoptera borealis*, Lesson, which had been discovered in the Pacific Ocean in 1910.

After a detailed discussion of Anderson's account, I concluded my remarks upon the species in the following words: " While from the foregoing discussion of *B. edeni* it is evident that this species is either identical with, or closely allied to, *B. borealis*, I feel that without further information no positive assertions can be made regarding it. The characters of the skull and atlas which have already been pointed out are certainly of importance and to my mind cannot be disregarded or explained upon the grounds of individual variation. Since Dr. Anderson especially noted them from the specimen itself it would appear that they have not been exaggerated in the published figures. It is highly desirable that this skeleton be reexamined in the light of present knowledge of the large Cetacea, but until this is done, or other specimens have been obtained from the same waters, it appears to me that it is wisest to leave *Balaenoptera edeni* as a very doubtfully established species.

" It is especially unfortunate that Mr. Orjan Olsen, who has recently described *Balaenoptera brydei* from South African waters, did not furnish osteological details with his external descriptions. Further information regarding both these whales will be awaited with interest since it is not improbable that the two may prove identical, or both the synonyms of *B. borealis*. At present, however, the wisest course is to leave them as they are " (*l. c.*, p. 378).

In July, 1917, while *en route* to New York after a year of zoological exploration in Yün-nan province, China, I reached Calcutta and

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[1] Anatomical and Zoological Researches: comprising an account of the Zoological Results of the Two Expeditions to Western Yunnan in 1868 and 1875. London, 1878, pp. 551-564, pl. xliv.

[2] Monographs of the Pacific Cetacea. II.—The Sei Whale (*Balaenoptera borealis*, Lesson). *Memoirs of the American Museum of Natural History.* New Series, Vol. I, Part VI, March 1916, pp. 376-378.

through the courtesy of Dr. N. Annandale, Superintendent of the Zoological Department of the Indian Museum, was given the opportunity to examine the type specimen of *Balaenoptera edeni* as well as a skeleton[1] referred to the same species which was secured on January 21, 1890, at Sidhi Island, Noahkolly (Noakhali), Bengal, by C. E. F. Tonnerre, Esq. The latter, I believe, has not been reported upon. Unfortunately I had to leave Calcutta rather hastily and was not able to examine the Sidhi Island skeleton in detail but several of the bones were removed from the storage case for my inspection.

The most important characters in which *B. edeni* differs from other species according to Anderson are in the skull and atlas. He says that the skull of this species is remarkable for the "*little downward shelving of the upper surface of the maxillae*;" also "in the character of its beak, which is long and slender, and much more forwardly directed than the beak of *B. schlegeli*" (=*B. borealis*).

These characters appeared to me to be of considerable importance from a study of Dr. Anderson's figures and I find that they truly represent the condition of the specimen. They are borne out, in a somewhat less degree, by a skull from Arakan (which was reported upon by Anderson) and in the Sidhi Island skull; unfortunately when I examined the latter the premaxillae were not in position but the bones appeared to be similar to those of the type.

The beaks of all three skulls are narrower at the base in proportion to the length and the breadth at the middle than are those of *B. borealis* and consequently the beak has a somewhat different shape. These characters appear to me to be of considerable importance but the others which Dr. Anderson mentions in his description are probably not beyond the limits of individual variation.

The atlas (pl. XV, figs. 1, 2) of this species is very interesting. Dr. Anderson remarks "The neural canal has considerable breadth (3 inches) and is much broader than high. The notch for the reception of the odontoid swelling of the axis lying below it is much contracted. The transverse process of the atlas is well-defined, rather long, but basally shallow; very different from the deep wing-like twisted transverse process of *B. schlegeli*, as figured and described by Flower. The articular surfaces of the axis practically meet below, being separated from each other by 0·25 inch in the dried bone, and have thus no facet between them as in *B. schlegeli* (=*B. borealis*), (*l. c.*, p. 558).

I verified Dr. Anderson's observations and drawings of the atlas from the type specimen and they are substantiated by the atlas of the Sidhi Island skeleton, figures of which are represented herewith. Comparison of the atlas of either of these specimens with any published figures of the corresponding bone of *B. borealis* will show immediately that the differences are just those which are pointed out by Dr. Anderson in the paragraph quoted above.

All of the skeletons of *B. borealis* upon which observations have been recorded, with one exception, have possessed cervical ribs ankylosed with the first thoracic ribs. Dr. Anderson remarks that a fragment of

[1] Specimen *b* in Sclater's *Cat. Mamm. Ind. Mus.*, II, p. 314 (1891).

the first left rib of the type of *B. edeni* was preserved and that it was "single-headed." The Sidhi Island skeleton exhibits a bifurcated first rib exactly as in *B. borealis* as may be seen from the accompanying figures (figs. 3, 4). While the presence or absence of a cervical rib has no specific value, nevertheless it is interesting since in *B. borealis* its presence is almost universal (see Andrews, *l. c.*, pp. 367-368).

The Sidhi Island skeleton, so far as I was able to examine it, appears to substantiate the characters pointed out by Dr. Anderson in the type specimen of *B. edeni.* While in almost any other group of mammals these would be deemed sufficient reason for separation from even closely allied forms, yet any naturalist who is familiar with the extraordinary individual variation among cetaceans will realize that it is unwise to make positive statements based upon a limited amount of material.

It is difficult for me to believe that the differences exhibited by these skeletons can be individual, and yet they must be strengthened by a knowledge of the external anatomy before the species can be said to rest upon a firm foundation. There is no doubt that it is a form very closely allied to *B. borealis* and it may possibly prove to be identical with the recently described *Balaenoptera brydei* from South Africa of which only the external characters are known.

EXPLANATION OF PLATE XV.

Bones from specimen of **Balaenoptera** from head of Bay of Bengal (Noakhali).

FIG. 1.—Articular surface of atlas vertebra.

,, 2.—Lateral view of atlas vertebra.

FIGS. 3 & 4.—First rib.

Specimen (*b*), Sclater, Cat. Mamm. Ind. Mus., II, p. 314.

S. C. Mondul, photo.

BALAENOPTERA EDENI, ANDERSON.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1918

XIII. ON THE ANATOMY OF CERTAIN INDIAN UNIONIDAE.

By Ekendranath Ghosh, *M.Sc.*, *M.D.*

(With Plate XVI.)

Introduction.

The genera and species of Unionidae discussed in this paper are :—*Lamellidens marginalis* (Lamarck), *Solenaia soleniformis* (Benson), *Physunio ferrugineus* and *Ph. micropteroides*, Annandale. These species resemble one another so closely in anatomical structure that I have considered it best to treat them together in a comparative manner.

The method of study was (1) simple dissection of the soft parts of the animals after removal from the valves, checked by (2) longitudinal (sagittal) section of the entire animal and (3) serial transverse section of the whole animal (into thin slices, 2-4 mm. thick) from one end to the other. The gills were studied microscopically after sectioning by the usual paraffin method. They have been specially studied with reference to the formation of the marsupium.

As regards the materials, the specimens of *Lamellidens* were procured from tanks about Calcutta, while the others were received from the Zoological Survey of India through the kindness of Dr. Annandale.

I. Mantle-lobes.

The *mantle-lobes* are free from each other from the antero-dorsal aspect of the anterior adductor muscle down along the ventral margins to the posterior margin as high as the postero-dorsal aspect of the posterior adductor muscle. Behind, the two lobes are joined to one another between the exhalent and inhalent apertures by a horizontal shelf formed by their fusion with the free dorsal margins of the outer lamellae of the outer gills and of the other lamellae of the gills to one another. The point of fusion of the mantle-lobes is placed just at the antero-dorsal aspect of the anterior adductor muscle in *Lamellidens* and *Solenaia*, but at a higher level in *P. ferrugineus* and less so in *P. micropteroides* ; further, this point forms the most anterior end of the lobes, and in the case of *Lamellidens* and *Solenaia* is placed at the level of the ventral border of the anterior adductor muscle. A small gap between the margins of the mantle-lobes is left above the posterior adductor muscle, exposing the dorsal wall of the rectum in both *Lamellidens marginalis* and *Solenaia soleniformis.* This gap is absent in both species of *Physunio.*

Above, each mantle-lobe is fused with the body-wall, the line of separation passing along the ventral aspect of the anterior adductor muscle, the base of the anterior lip of the mouth, and the attached dorsal margin of the anterior half of the outer labial palp ; the line of

separation is then reflected forwards in an acute angle along the ventral aspect of a triangular membrane attaching the dorsal margin of the labial palps to the side of the visceral mass, and ultimately curves backwards round the anterior end of the inner and then the outer gill (the line of curvature forming about $\frac{1}{3}$ the circumference of a circle). It then passes obliquely downwards and backwards nearly in a straight line along the ventro-lateral aspect of the non-glandular portion of the kidney. Behind the foot, a canal [1] intervenes between the non-glandular portion of the kidney and the line of separation. In *Lamellidens* the line is placed on the dorsal aspect of the canal, whereas in both *Solenaia* and *Physunio* it lies on the outer side of the canal itself. Furthermore, the line of attachment of the outer lamella of the outer gill is placed below the line of separation in *Lamellidens* and *Solenaia*, but in *Physunio* in this line. This line is oblique and situated on the outer side of the kidney ; it forms an acute angle with another line drawn from the anterior end of the outer gill to the posterior end of the attachment of the labial palps on their dorsal aspect in *Physunio* (more so in *P. ferrugineus* than in *P. micropteroides*), a right angle in *Lamellidens marginalis* and an obtuse angle in *Solenaia soleniformis*. Lastly, the line of separation passes along the ventral margin of the posterior adductor muscle to its posterior aspect, where it is joined to the opposite mantle-lobe through the intervention of the gills. It then curves round the posterior aspect of the posterior adductor muscle to join its fellow at the postero-dorsal aspect of the muscle.

The inhalent and exhalent apertures are bounded by the thick, pigmented margins of the mantle-lobes. The inhalent aperture is twice the exhalent aperture in height. The margin of the inhalent aperture is beset with tentacles in all the genera here described ; in *Lamellidens* and *Solenaia* the tentacles are short and stout and are nearly of the same size, and are arranged in a single row, but in *Physunio* they are elongate and conical and of three sizes which are arranged irregularly in three rows, the largest ones (larger than those in *Lamellidens* and *Solenaia*) being placed internally.

The exhalent aperture is smooth in *Solenaia* and *Physunio*, but provided with a row of minute tubercles in its extreme lateral margins in *Lamellidens*. The margins of the aperture extend further downwards in *Physunio* than in *Lamellidens* and *Solenaia*.

II. LABIAL PALPS.

The *labial palps*, outer and inner, are continuous in front with the anterior and posterior lips of the mouth ; they are elliptical in *Lamellidens* and *Solenaia*, but a little more elongate in *Physunio*. The point at which they are fused with the lips of the mouth forms a shallow concavity on the ventral margin in *Lamellidens* and *Solenaia*, but presents a slight flattening in *Physunio*. The labial palps are free from one another except in three-fourths the length of the dorsal margin from the anterior end ; they are connected with the body by a triangular membrane attached to their fused dorsal margin. The apex of the membrane

[1] To be described with the kidney.

is directed forwards and the base forms a free margin behind; the side fused with the wall of the visceral mass is overlapped by a small portion of the ventral margin of the inner gill.

III. Muscles.

(1) The *anterior adductor muscle* is irregularly triangular in shape in *Lamellidens* and *Physunio*, and rather obliquely pyriform in *Solenaia*. The relative position of the muscle and the pseudocardinal tooth or teeth in the intact animal varies with the different species described. In *Lamellidens* the anterior end of the tooth or teeth is placed just above the middle of the attachment of the anterior adductor muscle, while in *Physunio* it extends to the antero-dorsal angle of the muscle with a gap between the two.

In all the species described here the muscle is divided into an upper and lower portion by an oblique septum extending between the two valves.

(2) The *posterior adductor muscle* is triangular (with the apex above and the angles rounded) in *Lamellidens* and *Physunio*. In *Solenaia* it is elongated horizontally, with nearly parallel upper and lower borders and rounded ends; in the anterior and upper corner there is a notch to receive the posterior end of the muscle.

(3) The *anterior retractor muscle* of the foot arises from the base of the foot on its side, just behind the mouth; it passes obliquely upwards and forwards beneath the posterior lip of the mouth and on the inner side of the lower portion of the protractor muscle to be inserted into the valve just behind the anterior adductor muscle. In *Lamellidens* the surface of attachment lies along the lower two-thirds or more of the posterior margin of the adductor muscle, being widest below and tapering above. In *Solenaia* it is placed behind the upper third of the posterior margin of the adductor muscle, and is nearly circular in shape. Lastly, in *Physunio* it is elongately triangular with the apex below, and is placed behind the upper half of the posterior margin of the anterior adductor muscle.

(4) The *protractor muscle of the foot* arises on each side from the visceral mass above the base of the muscular foot. The fibres radiate from an obliquely placed triangular area and are collected into a very short column, which passes obliquely downwards and forwards to be inserted into the valve near the anterior adductor muscle. In *Lamellidens marginalis* the muscle is placed below and behind the adductor at a little distance from it; in *Solenaia* it is placed behind and a little below the anterior retractor, at a distance behind its ventral aspect. In *Physunio* it is placed behind the adductor at the level of its lower end and also at a distance from it.

(5) The *posterior retractor muscle of the foot* on each side arises from the extreme posterior and dorsal aspect of the visceral mass; the two muscles lie side by side in the middle line, pass obliquely upwards and backwards between the two kidneys (at their posterior portions) and are inserted into the valves above the level of the upper border of the kidneys and in front of the posterior adductor muscle. In *Lamellidens marginalis* the surface of attachment is more or less triangular in shape,

lying in contact with the upper end of the anterior aspect of the adductor muscle. In *Solenaia* also, it is triangular, but lies in contact with the notch in the posterior adductor muscle. In *Physunio* again it is triangular, but is placed above and in front of the dorsal aspect of the adductor muscle.

(6) The *elevator muscles* are arranged in two patches one on each side, on the dorso-lateral aspect of the visceral mass.

In *Lamellidens marginalis* each patch is placed at the junction of the anterior one-third and posterior two-thirds of the body length and consists of very short columns of muscles 5—7 or more in number and arranged irregularly ; they are at once inserted into that portion of the valve lying in front of the umbonal cavity. In *Solenaia* they are placed behind the region of the umbo. In *Physunio* they are placed above and behind the anterior adductor muscle far forward in position as compared with those of *Lamellidens* or *Solenaia*.

IV. GILLS.

The *gills* are more or less similar in *Lamellidens* and *Physunio*. They are elongated and placed obliquely, and are approximately 4 times as long as broad. The *inner gill* is wider and longer, and extends a little more forward than the outer one. The *outer gill* is narrow and pointed in front, narrow and tapering behind. The inner gill is wider than the outer and extends below the outer gill. In *Lamellidens* the outer gill is nearly of the same width all through except at the tapering posterior and rather abruptly narrowed anterior end. The inner gill projects downwards beneath the outer one more in the anterior two-thirds of its length than in its posterior one-third. In *Physunio* the outer gill is comparatively narrow, being widest near the middle of its length and tapering at both ends ; it presents a notch in the ventral margin near the anterior end ; the inner gill projects downwards most in front, slightly behind and least in the middle.

In *Solenaia* the gills are much narrowed and elongated, being about ten times or more as long as they are broad ; the inner gill extends a little more forward than the outer, as in the other species, and projects a little below the outer gill equally in its entire length except at the anterior end ; the anterior and posterior ends of the outer gills are narrower and more pointed than those of the inner gill.

ATTACHMENTS OF THE GILLS :—

(1) The *outer lamella of the outer gill* is attached to the inner surface of the mantle-lobe. In *Lamellidens* the line of attachment lies a little below the separation of the mantle-lobes from the body-wall, so that the outer wall of the outer suprabranchial chamber is formed by a portion of the mantle-lobe ; the case is similar in *Solenaia*. In *Physunio*, however, the line of attachment lies at the line of separation of the mantle-lobe from the body-wall. The attached margin of the outer lamella is placed on a higher level than that of the inner lamella in *Lamellidens* and *Physunio*, but at a lower level (or at least in the same level) in *Solenaia*.

(2) The *inner lamella of the outer gill* is attached to the side of the visceral mass, at its anterior end, the ventro-lateral aspect of the non-

glandular portion of the kidney and to the outer lamella of the inner gill behind the visceral mass and foot, from beneath the posterior adductor muscle.

(3) The *outer lamella of the inner gill* is similar to the preceding in its mode of attachment.

(4) The *inner lamella of the inner gill* is attached to the side of the base of the visceral mass and behind it to the inner lamella of the opposite inner gill to form the floor of the cloacal chamber. In *Lamellidens* the attached dorsal margin of the inner lamella is placed just below the glandular portion of the kidney, but towards the posterior end of the visceral mass it is displaced downwards from the kidney, so that the inner wall of the inner suprabranchial chamber in this region is formed by a portion of the side wall of the visceral mass ; in *Solenaia* the case is exactly similar to that in *Lamellidens.* In *Physunio* the attached margin is placed beneath the glandular portion of the kidney near the posterior end of the visceral mass, where it is suddenly displaced downwards, as in the other forms.

Suprabranchial canals.—(*a*) The *outer suprabranchial canal* is placed on a higher level than the inner in *Lamellidens* and *Physunio*, but on a lower level in *Solenaia.* In *Lamellidens* the canal is small in the beginning, but gradually widens out posteriorly and opens into the cloacal chamber on the undersurface of the posterior adductor muscle in the middle of its antero-posterior thickness. Elongately triangular anteriorly, it widens out into an equilateral triangle behind in transverse section. In *Physunio* the canal is elongated and slit-like in front, but elongately triangular (with base directed upwards) behind the visceral mass in transverse section ; it ends in the cloacal chamber at the anterior end of the ventral aspect of the posterior adductor muscle.

In *Solenaia* the canal is triangular in front, but quadrilateral at the posterior end of the visceral mass in transverse section, and terminates in the cloacal chamber in the middle of the antero-posterior length of the ventral aspect of the posterior adductor muscle.

(*b*) The *inner suprabranchial canal* in both *Lamellidens* and *Physunio* is slit-like in the beginning, becomes triangular posteriorly in transverse section and is nearly of the same height in its entire length. In *Solenaia* the canal is also slit-like in the beginning but becomes quadrilateral in transverse section at the end of the visceral mass ; it is, however, of greatest width (from above downwards) anteriorly, forming about half the width of the inner gill, but becomes less so posteriorly.

The *renal aperture* is placed in the inner suprabranchial canal ; in *Lamellidens* and *Physunio* at about the junction of the anterior one-third and posterior two-thirds of the line drawn from the anterior end of the inner gill to the posterior end of the visceral mass. In *Lamellidens* the aperture is slit-like and placed longitudinally, with a thick white rim ; in *Physunio* it is rounded and without any thick white margin. In *Solenaia* it is slit-like and placed longitudinally some distance behind the middle of the length of the visceral mass.

The *genital aperture* is placed below and a little in front of the renal aperture in the same canal in both *Lamellidens* and *Physunio.* In *Solenaia* the aperture could not be made out.

The *common canal*, formed by the union of the two *suprabranchial canals* behind the visceral mass, is shorter than the antero-posterior length of the cloacal chamber in *Lamellidens* and *Solenaia*, but nearly of the same length in *Physunio.*

STRUCTURE OF THE GILLS.—The specimens of *Solenaia soleniformis*, Benson, and *Lamellidens marginalis*, Lam., supplied me with gravid females, while the specimens of the two species of *Physunio* were all sterile. In *Solenaia* all the four gills act as marsupia, while in *Lamellidens* the outer gills only give rise to ovisacs. In *Physunio* the structure of the gills seems to show that the outer gills are concerned in carrying the embryos. The arrangement of the gill filaments and the formation of lateral tubes are shown in the following table :—

	Number of gill-filaments corresponding to one water tube or lateral tube.	Lateral tube.
Solenaia—		
Outer gill,	20—22	... Only outer lateral tube.
Inner gill,	12—18	... Only inner lateral tube.
Lamellidens—		
Outer gill,	16—20	... } Outer tube much more developed than the inner tube.
Inner gill,	12—15	... }
Physunio—		
P. ferrugineus—		
Outer gill,	25—28.	
Inner gill,	14—16.	
P. micropteroides—		
Outer gill,	20.	
Inner gill,	15—16.	

V. ALIMENTARY CANAL.

(*a*) The *mouth* is a transverse slit-like aperture bounded in front and behind by anterior and posterior lips continuous with the outer and inner labial palps respectively.

(*b*) *Oesophagus.*—The course of the oesophagus is different in the three forms : in *Lamellidens* it is slightly curved or broadly S-shaped, passing obliquely upwards and backwards through the digestive glands. In *Solenaia* it consists of a short nearly vertical portion (wide in the middle and narrow at both ends) and an elongated horizontal portion continuous behind with the stomach. In *Physunio* it consists of a vertical portion lying behind the anterior adductor muscle and a short horizontal portion (half as long as the vertical portion) continuous with the stomach behind.

(*c*) The *stomach* is surrounded by a digestive gland ; its cavity is very irregular with folds and furrows which are fairly constant in arrangement.

Behind the opening of the oesophagus and in the floor of the stomach is a transverse fold (tongue-like in *Lamellidens*, but rather conical and papilla-like in *Solenaia* and *Physunio*), with a furrow behind ; the fold is directed upwards and backwards from below and produced laterally to the lateral walls of the stomach. In *Solenaia* and *Physunio* there is another fold in front of the conical elevation at the junction of the oesophagus and stomach, which in *Solenaia* extends backwards and up-

wards from below, and in *Physunio* only marked in the right side. Behind the conical elevation is another slight eminence which receives the opening of the intestine in *Solenaia.* In *Lamellidens* the opening lies on or behind the eminence, while in *Physunio* it is placed behind it at the bottom of a cup-shaped depression itself surrounded by a raised margin. In all cases the opening of the intestine is placed to the left side of the middle line.

The posterior wall of the stomach is raised into a transverse fold in the middle of its width giving rise to two blind pouches ; the fold is continued into the lateral wall of the stomach, more in the case of *Lamellidens* than in the two other genera. The dorsal pouch is directed upwards and backwards, while the ventral pouch is directed transversely backwards.

In *Solenaia* there is another fold in the backwall of the dorsal pouch above the transverse one which passes obliquely outwards and downwards to meet the transverse fold at the side ; this ridge is faintly marked or absent in *Lamellidens*, but in *Physunio ferrugineus* a similar ridge, arising from the dorso-lateral corner of the dorsal sac, passes downwards and forwards to meet the transverse ridge at the postero-lateral wall of the stomach ; it is present only on the left side but a faint trace of it can also be made out on the right side. In this species also a fold arises from the right side of the cup-like depression (in which the opening of the intestine is placed), which passes obliquely upwards and to the right on the posterior wall of the stomach and ends below the transverse fold in the postero-lateral corner ; two other smaller and less prominent ridges are seen, one arising from the postero-lateral aspect of the margin of the same cup-like depression to the right and the other a little above the preceding from the oblique ridge, both passing to the left. Another strongly marked ridge is also found in the right lateral wall of the stomach at the level of the margin of the cup-shaped depression, continued behind to the origin of the oblique ridge from the margin of the cup. It forms a deep pouch on the ventro-lateral aspect of the stomach, the lower boundary of which is formed by the raised lateral margin of the cup-shaped depression.

In all the three genera the transverse ridge from the posterior wall of the stomach, as it passes to the *left side*, fuses with one from the antero-dorsal wall above and with another from the ventral wall of the stomach at its junction with the oesophagus, with the formation of a separate portion of the dorsal pouch on the left side.

(*d*) *Intestine.*—The coils of the intestine in the visceral mass are similar in fundamental arrangement in all the genera considered here. They may be best described in a tabular form :—

Loop of the Intestine.	*L. marginalis.*	*Solenaia soleniformis.*	*Physunio.*
(1) First loop, from the stomach to the posterior end of the visceral mass (course backward and downward on the left side of the middle line).	Course backward and downward.	Much more backward than downward.	Much more downward than backward.

Loop of the Intestine.	*L. marginalis.*	*Solenaia soleniformis.*	*Physunio*
(2) Second loop, passing forwards and upwards to the dorsal aspect of the visceral mass.	Course nearly straight, half the first loop in length.	Course slightly curved, about half the length of the first loop.	Course curved with convexity upward and backward, about the same length as the first loop.
(3) Third loop, passing downward and backward and lying behind the second loop.	Course like that of the second loop and slightly longer than the same.		
(4) Fourth loop, passing forward and lying beneath the posterior portion of the first loop.	Course straight, slightly upward and about half the length of the first loop, lies below the first loop.	Like *Lamellidens* but not upward (or very slightly so).	Course rather short, less than half the length of the first loop.
(5) Fifth loop, passing backward and downward. The junction between the fourth and fifth loops crossing the first loop.	Course straight, slightly shorter than the fourth loop, lying above the first loop.	Course straight, about half the length of the fourth loop, lying above the first loop.	Course about half the length of the fourth loop.
(6) Sixth loop, passing upward and forward to end in the rectum.	About the same length as the fifth loop, lying above the fifth loop.	Very short, about half the length of the fifth loop.	

(*e*) The *rectum* is recognised by a thick, prominent typhlosole from the ventral wall. Beginning in the visceral mass, it passes forwards and upwards to reach the space between the digestive gland and the stomach in front and the pericardial sac behind. It then passes vertically upwards and at once bends backwards to enter the pericardial chamber; it passes through the chamber, being surrounded by the ventricle, and leaves the chamber at its posterior end. Lastly, the rectum passes backwards along the dorsal aspect of the posterior adductor muscle and ends in the anus placed at the summit of a conical papilla projecting into the cloacal chamber from above the posterior adductor muscle. In *Lamellidens* the course of the rectum through the pericardial chamber is straight and horizontal; furthermore, it presents two bulb-like swellings in front of and behind the ventricle; the conical papilla is flattened from side to side and the anus is a longitudinal slit with two lateral dentate margins which ordinarily keep the aperture closed. In *Solenaia* it is similar to that in *Lamellidens* in all respects except that the swellings are absent. In *Physunio* the course through the pericardial chamber is oblique (upwards and backwards from in front) and is slightly curved posteriorly with the convexity upward after it has left the pericardium; there is no bulbous swelling in the wall and the anus is more or less rounded, being surrounded by a fringe specially prominent on the dorsal aspect.

VI. DIGESTIVE GLAND.

The *digestive gland* forms a brownish mass round the stomach; it extends above and in front from the antero-dorsal aspect of the stomach to the postero-dorsal angle of the anterior adductor muscle above the oesophagus, and above and behind from the postero-dorsal aspect of the stomach to the rectum ventrally; the gland extends from the oesophagus in front to the first loop of the intestine behind. In all species, except *Physunio ferrugineus*, the ducts of the gland are not clearly seen under a magnification of ten diameters; there are numerous tubular crypts in the wall of the stomach into which the gland seems to open. In *Physunio ferrugineus* the racemose nature of the gland is quite distinguishable under a magnification of 10 diameters, and the gland is divisible into 4 lobes—one antero-dorsal, one postero-dorsal, and 2 ventral. A long duct from each lobe is distinctly seen to open into the cavity of the stomach.

VII. VASCULAR SYSTEM.

The *vascular system* has been studied in *Lamellidens marginalis* by injecting the blood vessels with a coloured fluid through the ventricle, as living and fresh specimens are available. In other forms only the heart, the vena cava, and a few other vessels could be studied properly.

(*a*) PERICARDIUM.—In *Lamellidens* and *Physunio* the pericardial sac is elongately oval, with rounded ends; the sac is slightly more flattened in *Lamellidens* than in *Physunio*. In *Solenaia* the sac is narrow and elongated, the anterior end being flattened from above downwards. A distinct gap is seen between the posterior end of the pericardial sac and the dorsal aspect of the posterior adductor muscle in which the rectum is placed, being surrounded by connective tissue. In all a longitudinal fold of integument rises vertically upwards from the mid-dorsal line of the wall of the pericardium; this is only slightly marked in the case of *Lamellidens* and *Solenaia*, being more prominent in the latter behind the pericardium and over the posterior retractor and anterior half of the posterior adductor muscle. In *Physunio* this membrane is extraordinarily developed, and is prolonged as a thin median flap between the dorsal wings of the two valves. The *reno-pericardial aperture* is placed on the ventro-lateral aspect of the rectum as the latter enters the pericardial sac.

(*b*) HEART.—The *ventricle* in *Lamellidens* seems to be bilobed when it is fully expanded and placed in the middle of the pericardial sac (occupying about the middle-third of the entire length of the sac); it is bounded in front and behind by the bulbous swelling round the rectum. In *Physunio* the ventricle is placed close to the posterior end of the pericardial sac. In *Solenaia* it is about half the length of the pericardium and is placed in the middle of the sac.

The *auricles, right* and *left*, are placed at the sides of the ventricle. Each auricle in *Lamellidens* is triangular in shape, with the apex directed forwards. The outer side is attached to the conjoined margin of the inner lamella of the outer and outer lamella of the inner gill, just external to the dorsal aspect of the kidney. It is attached to the ventricle in

the middle third of its length. The auriculo-ventricular opening is a slit-like aperture guarded by 2 semilunar valves, above and below. There are 3 to 4 apertures inside the outer border of the auricle to receive blood from the efferent branchial vessel. In *Solenaia* the auricle is trapizoid in shape ; of the two parallel sides the short one is attached to the ventricle and the long one to the gills. There seems to be a single aperture to receive blood from the gills. In *Physunio* the shape of the auricles is similar to that in *Lamellidens* ; the apertures inside the outer side to receive blood from the gills are 4 or 5 (?) in number.

The following blood vessels have been traced in *Lamellidens* by injecting them with carmine (suspended in water) through the ventricle.

The *anterior aorta* passes forwards along the dorsal aspect of the rectum and reaches the posterior end of the digestive gland where it divides into right and left *viscero-pedal* arteries. Each *viscero-pedal artery* runs forward and a little outward into the substance of the superficial portion of the digestive gland, and then curving downwards and forwards gradually comes to reach the postero-ventral aspect of the anterior adductor muscle at the corner of the mouth, where it divides into two branches, *pallial* and *palpal* arteries. The *pallial artery* passes forward in the substance of the mantle-lobe along the ventral margin of the anterior adductor muscle to reach the antero-ventral angle of the latter, where it divides into two branches again : the first, the *dorsal pallial artery*, curves upwards and backwards along the anterior margin of the anterior adductor muscle (in the substance of the mantle lobe), supplying small arteries to that portion of the mantle which lies in front of the muscle and to the muscle itself ; the other, the *anterior pallial artery*, curves downwards and backwards and then runs backwards along the dorsal aspect of the thick rim of the mantle lobe, to the posterior end near the inhalent margin where it seems to divide into a net-work of capillaries ; it gives rise to numerous branches from both sides in its course along the mantle margin.

The *palpal artery* passes through the anterior lip of the mouth to the outer side and divides into *outer* and *inner* palpal branches ; the *outer* branch passes into the outer labial palp in a conspicuously sinuous course lying in the outer lamella of the two, of which each palp is composed ; the inner branch passes into the inner labial palp in a slightly undulating manner lying in the inner lamella.

The *anterior aorta* in its course through the visceral mass gives off minute branches to the stomach, and the digestive gland ; it also gives rise to a large *pedal artery* near the posterior end of the stomach.

The *pedal artery* passes downwards and forwards through the visceral mass and reaches the muscular foot at the junction of the anterior and middle thirds of its length and then passes nearly to the extreme margin ; it supplies branches to the intestine, rectum and the genital organs.

The *posterior aorta* is a very small artery arising from the ventral aspect of the posterior end of the ventricle beneath the rectum. It passes along the ventral surface of the rectum between the two posterior retractor muscles of the foot where it divides into 2 branches, one on either side. Each branch gradually passes outwards along the posterior retractor muscle and reaches the posterior surface of the posterior

adductor muscle. Each supplies the corresponding half of the posterior adductor muscle, the posterior retractor muscle of its side and the posterior portion of the rectum.

The *pallial sinus* (*vein*) begins in the substance of the mantle flap at the level of the inhalent aperture just behind the thick rim of the lobe. It passes upwards and forwards in a curved manner below the posterior adductor muscle and ultimately opens into the auricle of its side at the postero-external corner. This sinus is also present in the other two genera.

The *vena cava* (*median ventral sinus*) at first lies between the two glandular portions of the kidneys, but gradually shifts downwards in its posterior course so as to lie at the point of union of the two glandular and non-glandular sacs ; the ventro-lateral wall of the vena cava on either side is perforated with a row of apertures, the openings of vessels from the wall of the glandular portion of the kidneys ; they are distinctly seen under a magnification of 10 diameters. In *Solenaia* and *Physunio* the relation between the vena cava and the kidney is similar to that in *Lamellidens.* In *Lamellidens* and *Solenaia* the transverse section of the vena cava is oval, with the short diameter vertical ; in *Physunio* it is also oval but with the short diameter horizontal.

The two *afferent branchial veins* lie along the line of attachment of the inner lamella of the outer and outer lamella of the inner gill—in all the three genera.

The *single afferent branchial vein* lies along the base of the inner lamella of the inner gill in all the three genera. It is interesting to note that in *Anodonta* it lies along the base of the outer lamella of the outer gill.

VIII. Excretory System.

The *kidney* is doubled on itself, as usual, and is divisible into (*a*) glandular and (*b*) non-glandular portions.

The *glandular portion* of the kidney lies beneath the non-glandular ; at its anterior end it communicates with the pericardium and is separate from its fellow by a distinct interval, and further behind by the interposition of the vena cava. In *Lamellidens* the sac is flattened from above downwards in front, lying on the ventral aspect of the non-glandular sac. Then the sac becomes oval in transverse section and, lastly, towards the posterior end of the visceral mass it is twisted on itself coming to lie on the inner side of the ureter, at first obliquely (*i.e.*, with the long diameter in a section placed downwards and outwards from above) and then vertically. The vena cava is now placed beneath the pericardial sac, with a small portion of the inner wall of ureter and glandular sac laterally and further back with the glandular sac only, the ureter being displaced to the outer side.

In *Solenaia* the glandular sac is separated at first from its fellow of the opposite side by the vena cava, and behind by the foot, which intervenes between the two. The inner wall of the sac is fused with the upper portion of the side of the foot, while the non-glandular portion placed dorsally at first is displaced to the outer side.

In *Physunio* the glandular sac lies beneath the non-glandular portion in the beginning, but is gradually placed on its inner side between it

and the foot and the posterior retractor muscle of the foot of its side ; the glandular sac is comparatively wider than the non-glandular. The walls of the non-glandular sac are generally seen applied to one another.

The glandular sac ends in front of the posterior adductor muscle. The nature of the communication between the glandular and non-glandular sac is rather different in the three genera.

In *Lamellidens* the glandular sac opens into the non-glandular by means of a slit-like aperture on the dorsal aspect at its posterior end ; a pigmented sac is found at the beginning of the ureter, open in front but blind behind ; it lies on the outer side, having its outer wall fused with the outer wall of the ureter and its inner wall lying free in the cavity of the same ; the blind posterior end of the sac lies just in front of the posterior adductor muscle, the inner surface of the sac is thrown into irregular folds and gives the appearance of a broad meshed spongy structure.

In *Solenaia* the glandular portion is placed on the inner side of the non-glandular sac. Towards the posterior end of the foot we get the beginning of a canal bounded externally by the mantle, internally by the non-glandular sac, above by the pericardial chamber and below by the outer suprabranchial chamber ; the canal widens out as it passes backwards. Behind the foot it forms a big sac lying on the outer side of the glandular sac, while the non-glandular sac narrows down into a small canal lying on the outer side of the posterior retractor muscle of the foot above the canal. Further backwards, the non-glandular sac terminates in a small blind sac just in front of the posterior adductor muscle. On reaching the under surface of the posterior adductor muscle the canal comes to lie on its ventro-lateral aspect and ultimately becomes continuous with the glandular sac by the disappearance of the septum between the two. In the lumen of the canal, as it lies at the level of the posterior retractors of the foot, there is an obliquely vertical septum, attached above to the outer wall of the canal a little below the dorsal aspect, and below to the inner wall a little above the ventral aspect. The free anterior and posterior borders of the septum is deeply concave. Above the upper attachment of the septum is an elongated aperture through which the ureter communicates with the canal. A similar arrangement but rather different in details has been described in *Anodonta*.

In *Physunio* the glandular portion is placed on the inner side of the ureter behind and both are flattened from side to side and slightly curved on themselves, with the convexity outwards ; in this situation it is separated from its fellow of the opposite side by the posterior retractor muscles of the foot. The glandular sac communicates with the non-glandular by an elongated aperture on its dorsal aspect, near the posterior end. The glandular sac in this situation is divided into two portions by an oblique partition, attached on the inner side to the ventro-internal corner, on the outer side to the outer wall a little below the dorsal aspect and behind to the outer wall just in front of the posterior end of the sac ; it is free anteriorly. Of the two sacs thus formed the upper one communicates with the ureter, while the lower one ends blindly.

(*b*) The *non-glandular portion* passes forwards beneath the pericardial chamber. The relation of the non-glandular to the glandular sac has already been described. At the anterior end, the non-glandular sac is separated from its fellow by the vertical portion of the rectum. The excretory aperture is placed at the outer ventro-lateral aspect of the sac. The interrenal aperture is elongated in *Lamellidens* and *Solenaia*, but is less so in *Physunio*.

IX. REPRODUCTIVE SYSTEM.

The *gonads* are placed as usual amongst the coils of the intestine and a portion of the rectum in the visceral mass. In *Lamellidens marginalis* male specimens were available. The head of the spermatozoon is rod-shaped, about thrice as long as broad, rounded anteriorly, truncate or slightly concave, and widest posteriorly; there is a slight constriction in the middle. The tail is very fine and is about 3 or 4 times as long as the head.

X. NERVOUS SYSTEM.

The position of the ganglia is practically the same as that in *Anodonta*. The ganglia and the connectives could not be dissected out in *Solenaia*.

The *cerebro-pleural ganglion* of each side gives off (1) an *intercerebral connective* in front of the mouth, (2) a *pallial nerve* from the antero-lateral aspect, (3) a *cerebro-visceral commissure* and (4) a *cerebro-pedal commissure*. No other nerve was found arising directly from the cerebro-pleural ganglion.

The *pedal ganglion*, on each side, gives off 6 *nerves from the side* and receives the *cerebro-pleural commissure*. The otocyst lies inside the pedal ganglion.

The *visceral ganglion*, on each side, receives the cerebro-visceral commissure and gives off 3 nerves, a *branchial*, a posterior *pallial nerve*, and a small nerve to the posterior adductor muscle.

In *Lamellidens* the *branchial nerve* passes along the conjoined margin of the inner lamella of the outer and the outer lamella of the inner gill. It divides into two branches, one passing along the same margin and the other along the fused margins of the inner lamellae of the inner gills. The *posterior pallial nerve* divides into 3 branches :—(1) a small nerve to the mantle-lobe which passes to the attached margin of the outer lamella of the outer gill, a little in front of its posterior end; (2) a nerve to the mantle-lobe at the posterior end of the attached outer lamella of the outer gill; (3) a nerve to that portion of the mantle-lobe which forms the lateral wall of the cloacal chamber.

The *cerebro-visceral commissures* are placed side by side between the two glandular portions of the kidneys beneath the vena cava in *Lamellidens*. They are separated from one another by the lower end of the vena cava in *Physunio*.

SUMMARY.

The anatomy of the three genera of Unionidae dealt with in this paper agrees in general structure with that of *Anodonta* and *Unio* as

already described by various malacologists. The difference observed between the three genera and others consists mainly in the relative position of the different organs, a remarkable point being the arrangement of the various loops of the intestine which are practically identical in four species described here. Further, the main differences in general structure between the three genera described here are only due to the elongation of the body in the antero-posterior direction, this being greatest in *Solenaia* and least in *Physunio,* with *Lamellidens* occupying an intermediate position between the two. Considering the individual organs, it is important to note that in *Solenaia* all the four gills seem to give rise to ovisacs, and the kidneys also are more complicated than in the other two, somewhat resembling those of *Anodonta.*

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EXPLANATION OF PLATE XVI.

FIG. 1. *Lamellidens marginalis,* showing the various organs diagrammatically. Nat. size.

,, 2. *Solenaia soleniformis,* showing the various organs diagrammatically. Nat. size.

,, 2 *a-d.* Vertical sections through *Solenaia soleniformis* showing the relation of the glandular and non-glandular sacs (diagrammatic).

,, 2 *c.* Diagram of the communication of the glandular and non-glandular sacs—

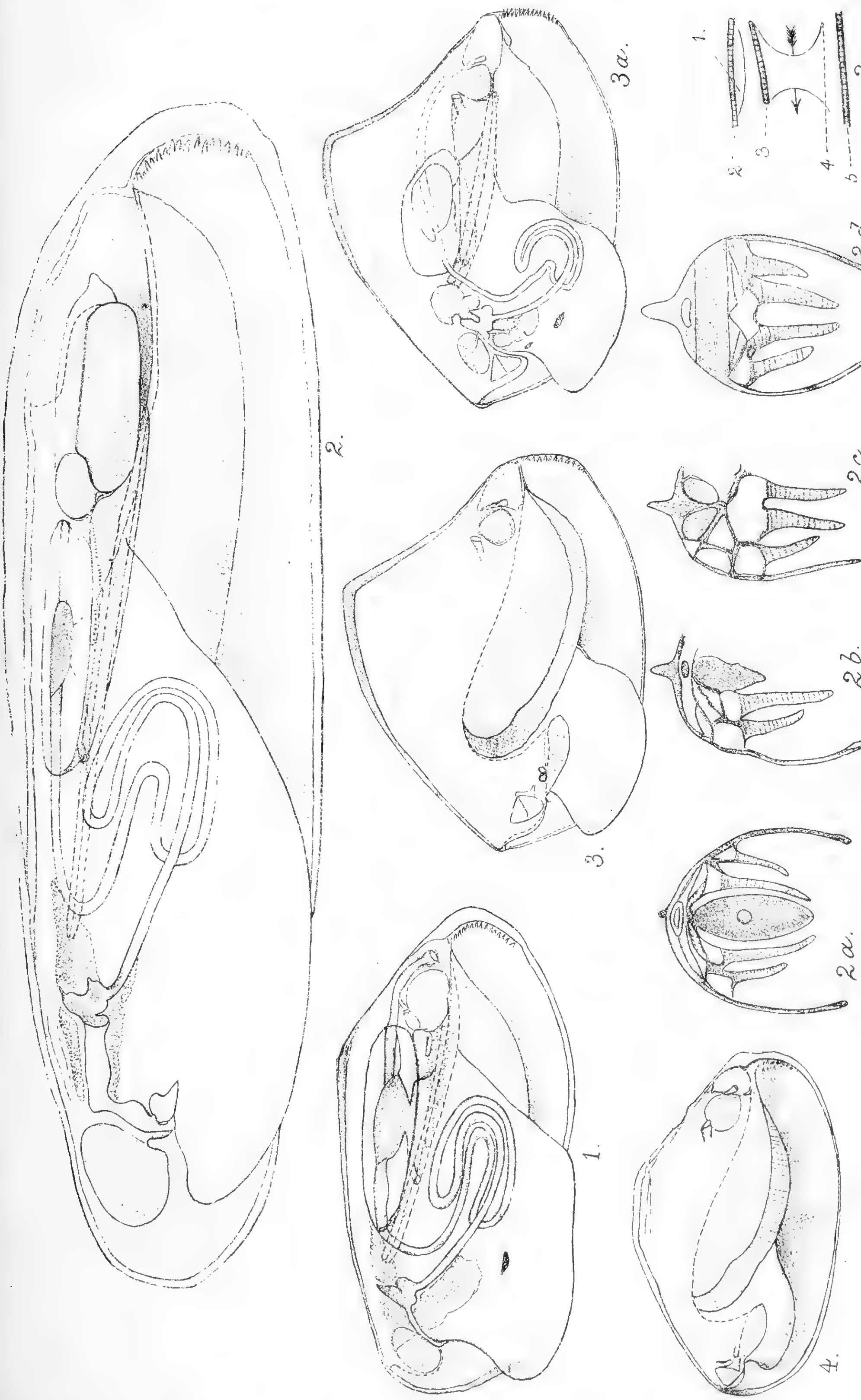
1. Opening of the non-glandular sac into the accessory canal.
2. Cut edge of the mantle lobe.
3. Attached margin of the membrane to the outer wall of the canal.
4. Attached margin of the membrane to the inner wall of the canal.
5. Cut edge of the mantle.

,, 3. *Physunio ferrugineus,* nat. size, shell and mouth of the left side removed.

,, 3 *a. P. ferrugineus,* showing the various organs diagrammatically.

,, 4. *P. micropteroides,* nat. size, shell and mantle of the left side removed.

The attachments of the gills are represented by interrupted lines.



E. N. G. del.

A. Chowdhary lith.

XIV. THE DESCRIPTION AND LIFE-HISTORY OF A NEW SPECIES OF *ANOPHELES* THAT BREEDS IN HOLES IN TREES.

By B. Prashad, *D.Sc.*

(Plate XVII.)

Though it may not be considered right to describe a species of mosquito from a single specimen and that specimen a male one, yet the specimen on which I base the following description possesses some very distinctive features. It is these features together with its breeding habitat and the presence of well preserved larval and pupal stages which have decided me to describe the form in question.

I have very great pleasure in naming it *Anopheles annandalei*, after Dr. N. Annandale, Director of the Zoological Survey of India, as a mark of regard and gratitude which I always feel for him.

The Imago.

Detailed description of the male specimen : A medium sized mosquito ; wing measured 2·9 mm. General colouration light.

The *antennae* have the basal joint of a light brown colour ; in the succeeding joints the proximal portion from which the hairs arise is dirty yellow, and the distal portion is of a creamy colour ; the hairs themselves are pale yellowish ; the last joint is densely covered with small hairs, there being no definite terminal hair. *Palpi* (fig. 1) 1·7 of length of thorax, ·6 of that of wing, distinctly smaller than the proboscis ; they have a distinctly banded appearance. Basal segment with large black scales on the outer and smaller ones on the inner side ; the penultimate segment has the base and the apex creamy white, the rest of the segment being dark brown ; the terminal segment has the base, the outer and upper surfaces brownish, the rest being yellowish white ; the club has the inner and lower surfaces of a much lighter tinge, appearing creamy white. The club is well developed, having a swollen terminal portion, and is covered by large scales with a few hairs. *Proboscis* dark-scaled : *labellae* whitish. *Clypeus* not covered by scales ; *vertex* with long hair-like scales of a whitish colour ; further back these hair-like scales are much darker in colour ; besides the hair-like scales there are broad truncated squames of a snow-white colour on the posterior portion of the vertex ; the *nape* is covered by black scales of the usual anopheline type.

Prothoracic lobes pointed anteriorly with a tuft of dark brown scales on their anterior edge, and with a few yellow chaetae. *Mesonotum* ashy grey all over except for a black line in the middle of the posterior third ; but for a few white spatulate scales on its anterior edge it is covered by long golden yellow bristles arranged in a median and two dorso-lateral areas, the rest of the surface being without any scales or

hairs; each of the areas mentioned above has three to four distinct rows of bristles arising from black rounded spots. A few bristles also arise from the dorso-pleural suture. *Scutellum* whitish except for a black band in the middle. *Postscutellum* with alternating bands of grey and brown in a longitudinal direction. Laterally the thorax is dark brown except at the sutures, which are light yellow.

Wing (fig. 2) 2·7 the length of thorax, base to subcostal junction ·61, anterior forked cell ·23, posterior forked cell ·15 of the whole wing. Wing veins densely covered with spatulate scales. Costa dark-scaled all along except at the base near the junction of the humeral cross-vein, where there is a yellow-scaled spot involving the base of the first longitudinal also. The second yellow spot is a large one at the apex of the wing opposite the termination of the first longitudinal and extending more than half the length of the anterior forked cell. All the veins clothed with dark yellow scales except for the following five patches of black scales: (1) at the base of the second longitudinal vein, (2) at the forking of the second longitudinal vein, (3) at the base of the third longitudinal and at the same position on the second and fourth longitudinal veins, covering the cross-veins as well, (4) at the origin of the fourth longitudinal vein and (5) at the forking of the fourth longitudinal vein. The wing-fringe is of a darkish hue with jet black patches at the tips of the posterior branch of the second longitudinal and the anterior branch of the fourth longitudinal veins; between these two dark patches the fringe is of a yellow colour. The arrangement of large and small scales in the fringe is quite normal.

Halteres with the capitellum of a dark brown colour, the scape and scabellum being yellowish.

Coxae scaleless, of a creamy colour with a few hairs; *trochanters* also with a few hairs and of the same colour as coxae. Fore legs uniformly brown except for the white spots at the femoro-tibial and the tibio-tarsal joints. The femur of the middle legs has a three-coloured band owing to the arrangement of the scales; it is formed of white scales in the middle, black above and brownish at the tip of the femur. In the hind legs the femur (fig. 3) has, just below the middle, a large tuft of black scales surrounding it entirely; below this tuft there is a very prominent tuft of snow-white scales reaching to the knee-joint, the condition appears to be simply a much more exaggerated one than that found in the femur of the mid-legs, except that the brown band at the tip of the femora of the middle pair of legs is absent. The tibial and tarsal portions of the mid and hind pairs of legs are uniformly brown except for a whitish band at the tibio-tarsal joints. *Ungues* simple.

Abdomen dark brown, without any scales except a few black ones on the last segment and on the genitalia; it is covered by a large number of golden yellow bristles.

The structure and form of the egg is not known.

THE LARVA (fig. 4.)

The *head* is of a dark brownish colour with three pairs of branched hairs on its dorsal surface. The *clypeal hairs* are rather small, the inner

pair being unbranched and lying close together; the distance between them being about half that between each external and the corresponding internal hair of the side; the inner hair is more than one and a half times the length of the outer branched hair. The *antennae* are long (little less than half the length of the head) cylindrical structures broader at the base, with minute spines on the shaft, with the processes at the apex well developed with a branched terminal hair arising from amidst them. From close to the base of the antenna there arises on the outer side a much branched *basal hair* of the type described for *A. culiciformis* by Christophers and Khazan Chand (6). *Mandibles* (fig. 5) with a single pointed and slightly curved, and three comb-like spines at the apex externally, a well developed anterior and a much smaller internal buccal fan of setae; four main teeth and seven accessory small ones; a brush-like large spine external to these and a prominent row of small tooth-like structures on the inner side; on the main lobe near the outer side a large number of small setae are present on the upper surface, and a number of hairs arising from near the base probably representing the branched basal hair. *Maxillae* of the ordinary pattern, with large curved hairs on their anterior margins, the inner edge ending on the top in a curved hook-like structure; on the main plates two minute papillae are present and the upper surface is covered by a large number of hairs. The maxillary palp is a prominent structure with five spines at its upper end, and a large much branched hair external to the processes a little below the tip. The *submental plate* shows nine well developed teeth.

Thoracic hairs as in other anopheline larvae. The *submedian* hairs consist of two branched hairs on each side, an external and an internal one. There are no palmate hairs on the thorax.

The first and second abdominal segments carry on each side two large and a small feathered hair; the third segment has one large and a single small feathered hair laterally and two small simple hairs dorso-laterally; the fourth and the fifth segments have one large and three small feathered hairs on each side besides two simple hairs as in the third segment; the sixth segment has a single large and two small feathered hairs and two unbranched ones as on the fifth segment; the seventh and the eighth have only two small feathered hairs on each side.

Palmate hairs are present on the abdominal segments 2—7 only. Each palmate hair (fig. 6) consists of 15—18 leaflets; the leaflets are long and pointed with one or two serrations on each side. The *pecten* (fig. 7) is short and broad with teeth of different lengths irregularly alternate, and with a few hairy projections on the basal parts only.

THE NYMPH.

The nymphal trumpets (fig. 8) are rather elongated structures somewhat triangular in shape, and with a broad opening. The dorsal plumose hairs of the ordinary shape are present on the first abdominal segment. There is a lateral spine on segments 2—8; the one on the last segment being plumose. Besides the spines mentioned above there is a long plumose seta, about the length of the segment bearing it, on the segments 5—7; the one on the fifth segment is a little smaller than the others. The tail-fins (fig. 9) are much longer than broad; they have

a well marked fringe of fine hairs, and a long terminal hair which is $\frac{1}{8}$ of the tail-fins in length.

HABITS.

The only adult specimen was hatched from larvae collected by Dr. N. Annandale and Dr. F. H. Gravely from a tree hole at Sureil (altitude about 5,000 ft.) in the Darjeeling district, Eastern Himalayas on October 28th, 1917. The tree was in dense jungle close to the source of the water supply of the Sureil bungalow. The water, which was of a brownish colour, contained a large number of dead leaves, and besides the anopheline larvae there were in it some culicine larvae as well. Only two other Indian anopheline mosquitoes have been described as breeding in tree-holes, these are *A. plumbeus*, Haliday (5) and *A. culiciformis*, Cogil (6).

REMARKS.

The present species belongs to the group of anophelines in which Alcock (1) included *A. asiatica*, Leicester, *A. barbirostris*, Van der Wulp, and *A. wellingtonianus*, Alcock (2) ; Christophers, however, in his admirable revision of the anophelines (3) includes in this group *A. asistica*, *A. lindesayi*, Giles, *A. wellingtonianus*, and doubtfully *A. atratipes*, Skuse, and thinks that *A. barbirostris* has no relations with this group. *A. annandalei* though closely related to *A. asiatica* (6), differs from it in the following important characters among many others :—

1. Wing markings.
2. Palpi being banded.
3. Markings of the legs.
4. General colouration.

The larva is quite different from that of *A. asiatica* as described by Strickland (*Parasitology*, Vol. VII, pp. 12—17, 1914).

Type specimen in the collection of the Zoological Survey of India, No. 8061/H. I. Larvae and pupa No. 8062/H., I.

I would here call attention to a paper by F. W. Edwards of the British Museum on "Tipulidae and Culicidae from the lake of Tiberias and Damascus" published in the *Journal of the Asiatic Society of Bengal*, new series, Vol. IX, pp. 47—51, in which he has, after careful comparison of the types come to the conclusion that *Anopheles nursei*, Theob. is only a synonym of *Anopheles* (*Pyretophorus*) *palestinensis*, Theob., and not a valid species. The paper has unfortunately been overlooked by all workers on Indian Culicidae.

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7. THEOBALD, F. V.—New Culicidae from the Federated Malay States. *The Entomologist,* Vol. XXXVII, 1904. (Leicester's original description of *A. asiatica.*)

EXPLANATION OF PLATE XVII.

Fig. 1.—Palp of the male *A. annandalei.*

,, 2.—Left wing of the same.

,, 3.—Hind femur of the same.

,, 4.—Larva of the same, dorsal view.

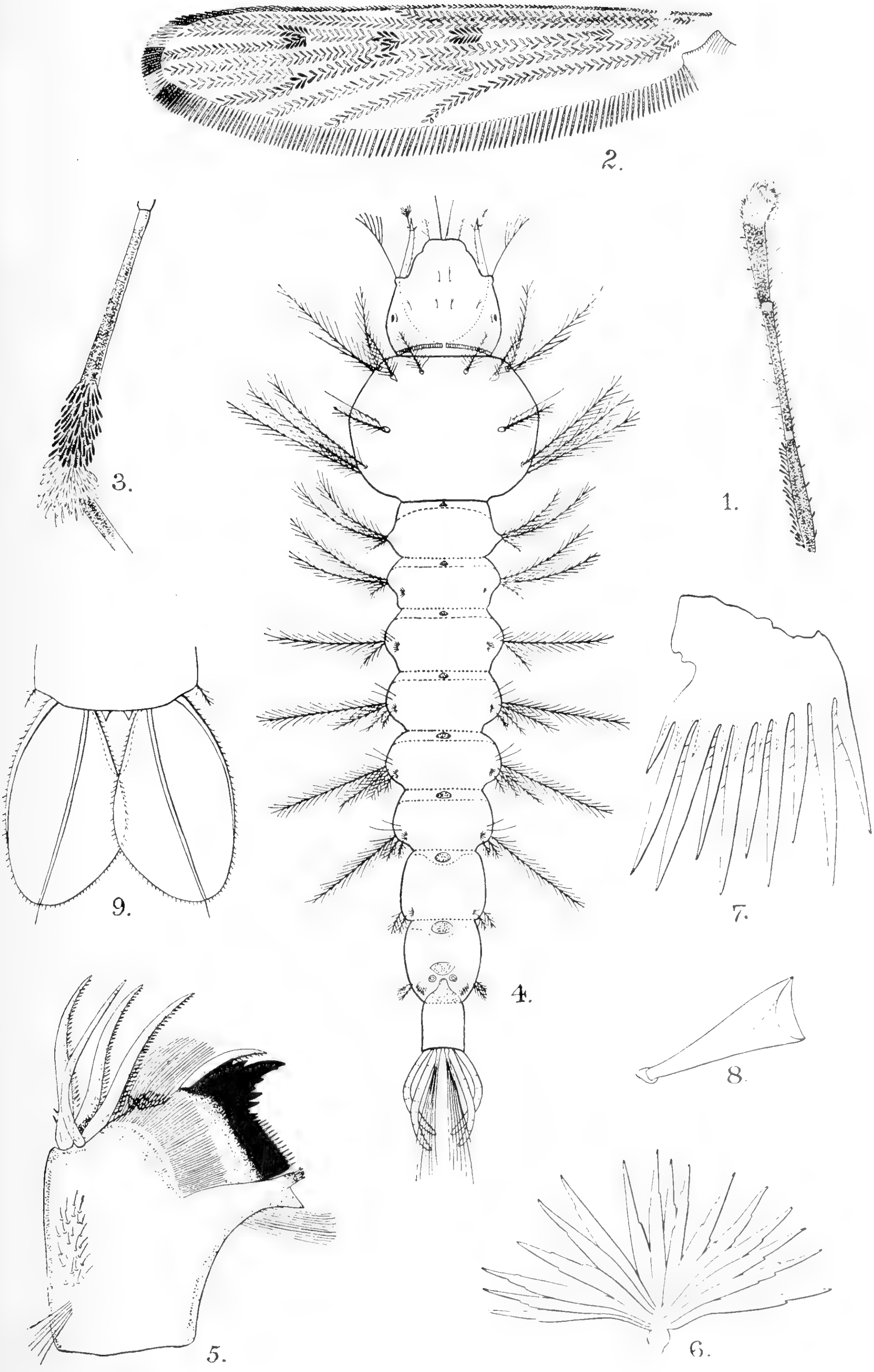
,, 5.—Mandible of the larva.

,, 6.—Palmate hair of the larva.

,, 7.—Pecten of the larva.

,, 8.—Breathing trumpet of the nymph.

,, 9.—Tail-fins of the nymph.



B. P. & D. Bagchi. del.

ANOPHELES ANNANDALEI.

XV. STUDIES ON INFUSORIA.

By Ekendranath Ghosh, *M.Sc., M.D.*

I. On a new species of *Anoplophrya*, Stein, *emend.* Cépède.

The genus *Anoplophrya*, Stein, as restricted by Cépède (2) may be diagnosed as follows :—Infusoria with flattened ribbon-shaped body (cylindrical in one species) entirely and uniformly covered with cilia arranged on longitudinal striae close to one another (rarely distant) ; no cytostome ; with well defined macro- and micro-nuclei ; c. v. in single or double longitudinal rows, or rarely scattered, or very rarely absent. Division by transverse fission, sometimes with formation of chains (*i.e.*, with satellites) due to incomplete and retarded separation of the daughter individuals. Endoparasites of various annelids.

Anoplophrya lloydii, sp. nov.

The species may be diagnosed thus : Elongately oval with sub-truncate posterior end ; curved longitudinally with the dorsal side convex and the ventral concave ; macronucleus irregularly ribbon-shaped, extending to nearly the whole length of the animal ; micronucleus small,

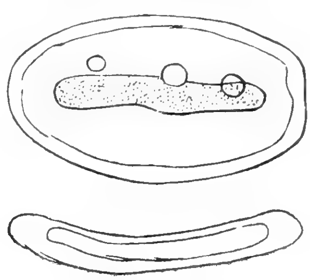


Fig. 1.—*Anoplophrya lloydii*, sp. nov.

spherical, placed at the side of the macronucleus ; c. v. 3, on the right side. In seminal vesicles of an earthworm (*Pheretima posthuma*). Unfortunately the measurements are not noted.

The species comes nearest to *A. striata* in many respects.

Up to the year 1915, the number of well recognised species of *Anoplophrya* was 16, making a total of 17 with the present one.

These species of *Anoplophrya* may be tabulated in the following synopsis :—

a. No C. V.

a¹. Body elongately oval, pointed anteriorly, truncate (when with satellites) or tapering and pointed posteriorly ; macronucleus ribbon-shaped, with a knobbed end.

1. *A. maupasi*, Cépède (2), p. 411.

b¹ Body ovoid or uniform ; rounded anteriorly, swollen and acuminate posteriorly ; only 4 or 5 longitudinal ciliary striae ; macronucleus spherical or ovoid, in posterior body half.

2. *A. minima*, Leger and Duboscq (3) ; Cépède (2).

b. With C. V.

a[1]. C. V. in a single row.

a[2]. Body oval.

a[3]. Body straight dorso-ventrally.

a[4]. Body elongately oval, length = 3 to 5 times the breadth ; sometimes obliquely truncate posteriorly. C. V. 9-10 or more ; macronucleus elongated and axial.

3. *A. naidos*, Stein (*A. inermis*, Kent.)

b[4]. Body elongately oval with rounded ends ; length equal to or less than twice the breadth ; C. V. large, 3-5 in number ; macronucleus elongately oval.

4. *A. ovata*, Clap.

b[3]. Body curved dorso-ventrally in a longitudinal direction, oval with rounded ends ; C. V. 4-6 in number ; long ribbon-shaped macronucleus with rounded ends.

5. *A. convexa*, Clap.

b[2]. Body not oval in shape.

a[3]. Body bilobed with a constricted portion in the middle ; anterior lobe swollen and oval ; posterior lobe less so and pointed behind ; C. V. 4-7 in number ; macronucleus oval and placed at the anterior end.

6. *A. cochleariformis*, Leidy.

b[3]. Body not bilobed.

a[4]. Body elongately club-shaped ; dilated anteriorly and obliquely truncate ; posterior end attenuate, rounded or acuminate ; C. V. 6 or 7 ; longitudinal striae few in number with distinct intervals.

7. *A. clavata*, Leidy.

b[4]. Body elongated and vermiform.

a[5]. Body cylindrical, little or not flattened, rounded anteriorly and acutely pointed posteriorly ; cilia long ; C. V. 7 ; macronucleus with club-shaped anterior end.

8. *A. paranoides*, Pierantoni (5).

b[5]. Body flattened ; macronucleus ribbon-shaped ; C. V. numerous (about 30 in number).

a[5] Animal free-swimming with ordinary movement, micronucleus spherical and granular.

9. *A. filum*, Clap.*

b[5]. Animal moving by vermicular contractions of the body ; micronucleus inconspicuous.

10. *A. vermicularis*, Leidy.*

b[1]. C V. in 2 rows.

a[2]. Body oval in shape,

a[3]. Body oval, more pointed anteriorly than posteriorly, sometimes both ends rounded ; macronucleus with lateral expansions (not distinctly branched) and with a distinct nucleus membrane ; micronucleus fusiform and placed obliquely in the outermost layer of endoplasm at a distance from the macronucleus.

11. *A. alluri*, Cépède.

b[3]. Body elongately oval, widest anteriorly, often with a number of satellites (*A. prolifera*), macronucleus axial, band-like ; micronucleus fusiform in posterior body half.

12. *A. nodulata*, Müller.
(*A. brasilii*, Leg. and Duboscq).

c[3] Body triangular, narrow and rounded anteriorly, truncate posteriorly.

13. *A. pachydrili*, Clap.

c[1]. C. V. scattered irregularly.

a[2]. Body curved dorso-ventrally in a longitudinal direction.

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* The species *A. filum* and *A. vermicularis* are considered identical by Schewiakoff (6), but are taken to be distinct and separate by Cépède (2).

a³. Body elongately oval; length equal to or less than twice the breadth: longitudinal ciliary striae at distant intervals; macronucleus with lateral expansions and approaching the concave face; fusiform micronucleus placed obliquely near the left border.

14. *A. striata*, Duj.

b³. Body elongately oval with subtruncate posterior end; longitudinal striae close; macronucleus irregularly ribbon-shaped; micronucleus spherical and placed at the side of the macronucleus; C. V. 3, on the right side.

15. *A. lloydii*, n. sp.

b². Body straight in profile.

a³. Body oval in shape; C. V. 10 in number.

16. *A. aegitensis*, Cépède (2), p. 543.

b³. Body irregularly oval, tapering and rounded anteriorly, wide and truncate posteriorly; C. V. 2, on one side, one in the middle and one near the posterior end; macronucleus irregularly oval, placed transversely; longitudinal striae close.

17. *A. simplex*, Andre (1).

Insufficiently described species:—

1. *A. socialis*, Leidy. Oval, cordioform, fusiform or globular in shape; C. V. numerous.
2. *A. notei*, Foulke, 1885 (*Amer. J. Sci.* XXIII, pp. 377-378), resembling *A socialis*, but without ciliary striae, cilia long and much thickened.

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II. TWO NEW SPECIES OF *Conchophthirus*, STEIN.

The genus *Conchophthirus*, Stein, may be diagnosed by the following characters: Body colourless and non-contractile, strongly compressed, generally oval in shape (sometimes elongated), with ventral surface usually more convex than the dorsal and somewhat notched in the ventral region; right side (back) more arched than the left; peristome a cup-shaped, funnel-shaped or short tubular cavity, sometimes prolonged into a long, recurved, tubular cytopharynx (non-ciliate); ciliary striae distinct; cilia uniform, moderately long and mostly tufted, sometimes a strong adoral zone in the anterior peristomial margin. C. V. mostly one, subcentral or postero-terminal, macronucleus spherical oval, or irregularly triangular, one, rarely seven in number, subcentral or terminal. Anus terminal. Ectoparasites in mantle chamber of various molluscs.

The genus included 3 species in Kent's *Manual of Infusoria* (1880-1882), *viz.*:—*C. anodontae*, *C. steenstrupei* and *C. curtes*. *Plagiotoma acuminata* Clap. and Lach. seems to be identical with *C. anodontae.*

Bütschli (2) in Protozoa, Bronn's *Thierreich* (p. 1720) included three more species: *C. actinarium* [*Plagiotoma actinarium* Clap. (5)], *C. magna* [*Tillina magna*, Gruber (7)] and *Plagiopyla nasuta* var. *marina* Gourret and Roeser (6). The first species is now made the type of a new genus *Foettingeria* by Caullery and Mesnil (3) and is also noted by Andre (1).

The second one is not recognised by Schuberg (10) as a species of *Conchophthirus* the cytopharynx of *Tillina* being ciliated. The third species also cannot be considered to belong to the present genus.

Schuberg also refused to admit *C. curtes* as a distinct and separate species from *C. anodontae* as they were found in the same host; he considered the former as a variety of *C. anodontae*. But as *C. curtes* has only been found in *Lamellidens marginalis* with two new species of *Conchophthirus* (to be presently described), it cannot be considered to be the same species as *C. anodontae*.

Lastly three other species have been described by Certes (4), Andre (1) and Mermod (9), raising the number to 6 in all.

The two new species of *Conchophthirus* have been found in the mantle chamber of *Lamellidens marginalis* with *C. curtes* in the same specimens, the latter being exceedingly rare in occurrence.

Conchophthirus elongatus, sp. nov.

Body elongated, about $2\frac{1}{2}$ times as long as broad, wide anteriorly, anterior end rounded and sloping to the back (left side); rather abruptly tapering and bluntly pointed at the posterior end; right side nearly straight, slightly convex in front and behind, and faintly

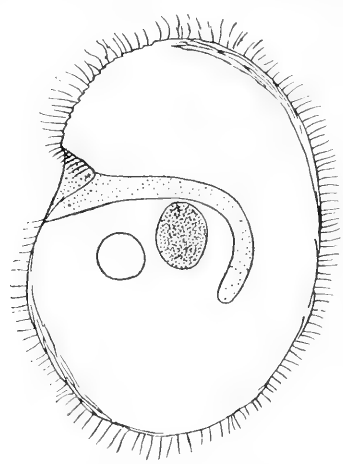

FIG. 2.—*Conchophthirus elongatus*, sp. nov.

concave in the middle; left side with a shallow notch just behind the anterior one-third of the body-length, where the peristome is situated; peristome small, elongately conical, directed forwards and to the right; longitudinal ciliary striae very marked at the anterior end, less so on the remainder of the body. Macronucleus oval, posterior and subterminal. C. V. single at the junction of the middle and posterior one-third of the body-length, sometimes slightly displaced. Length 0·05 mm.

Conchophthirus lamellidens, sp. nov.

Body ovate, about $1\frac{1}{2}$ times as long as broad, bluntly pointed at both ends; right side strongly convex, left side convex and minutely

dentate in the anterior and slightly notched in the posterior half. Peristome in the anterior portion of the notch, short and tubular, being directed forwards, and to the left. Generally a dark granular zone in the anterior one-third of the endoplasm. Longitudinal striae

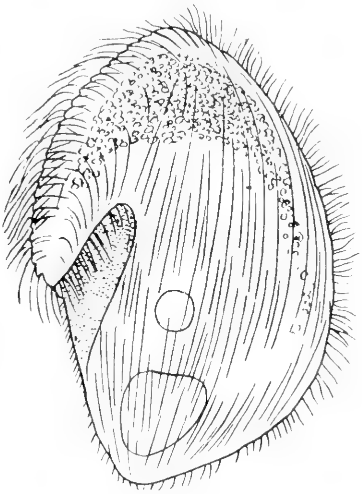

FIG. 3.—*Conchophthirus lamellidens*, sp. nov.

very distinct, specially in the anterior half of the left margin. Macronucleus oval or triangular, posterior and subterminal. C. V. one, subcentral, generally in the middle third of the body-length at its posterior end. Length 0·09 mm.

Conchophthirus curtes, Engelmann.

My specimens differ from the specimens described by Engelmann in the following points: The oval macronucleus is mostly placed with its long axis in the same line as the long axis of the body. C. V. without accessory vesicles. The cytopharynx is not only directed backwards (to the right side) but also curves posteriorly at a little distance behind the macronucleus.

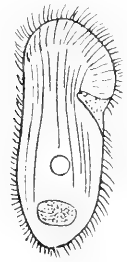

FIG. 4.—*Conchophthirus curtes*, Engelm.

The species of *Conchophthirus* are thus raised to 8 in number. They may be tabulated in the following synopsis :—

a. Peristome in the anterior body half far removed forward from the middle of the body-length.

a[1]. Peristome widely cup-shaped, at the anterior end of the left side; a small fascicle of bristles anteriorly; macronuclei 7 in number (moniliform ?); C. V. sub-central; body oval, body length = $1\frac{1}{2}$ times the width, length 0·13 to 0·093 mm.

1. *C. steenstrupei*, Stein.

b^1 Peristome small, near the anterior end; no fascicle of bristles anteriorly: macronucleus sing'e.

a^2. Peristome ending in a short recurved cytopharynx; macronucleus spherical or oval, subcentral; C. V posterior; body elongately oval, length = twice the breadth, length 0·07 mm.—0·110 mm.

2. *C. antedonis*, Andre.

b^2. Peristome small and conical, at about the junction of the anterior and middle thirds of the body length; macronucleus oval, posterior; C. V. at about the junction of the middle and posterior thirds of the body length; body elongated, length = $2\frac{1}{2}$ times the breadth; length 0·05 mm.

3. *C. elongatus*, sp. n.

b. Peristome in or near the middle of the left side.

a^1. Peristome ending in a long recurved cytopharynx passing to the right side.

a^2. Surface of the body smooth.

a^3. Body elongately oval, rounded at both ends; length = twice the breadth; macronucleus spherical and posterior; C. V. subcentral.

4. *C. anodontae*, Ehrbg.

b^3. Body broadly oval or rounded with dorsal surface strongly convex and ventral surface flattened; macronucleus oval, subcentral; C. V. one, near the macronucleus, with or without accessory vesicles.

5. *C. curtes*, Engelm.

b^2. Surface of body with longitudinal ridges in its middle two-thirds; body ovate, narrow anteriorly; macronucleus reniform; C. V. posterior and subterminal.

6. *C. metschnikoffi*, Certes.

b^1. Peristome not ending in a long recurved cytopharynx.

a^2. No adhesive disc; body oval with a notch in the posterior half of the left margin; body length = $1\frac{1}{2}$ times the width; body length 0·09 mm.; peristome tubular; macronucleus oval and posterior; C. V. in posterior body-half.

7. *C. lamellidens*, sp. n.

b^2. An adhesive disc occupying $\frac{2}{3}$rds of the ventral surface; peristome oval, behind the middle of the left side; body oval, rounded at both ends; right side convex; ventral surface flat and dorsal surface convex; C. V. in posterior body-half; macronucleus spherical or ovoid. Length 0·092—0·127 mm.

8. *C. discophorus*, Mermod.

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XVI. THE EVOLUTION OF THE CAUDAL FINS OF FISHES.

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(With text-figures 1—3.)

There is ample justification for the assumption that the most specialized of caudal fins among fishes have been evolved from a simple type which formed a part only of a once continuous median fin-system, extending from immediately behind the head on the dorsal side round the posterior end of the body to the vent on the ventral side ; thus there was no caudal fin as a differentiated structure. The whole of this primitive median fin-system was almost certainly provided with similar skeletal elements throughout, probably of the nature of interspinous bones or radials, not unlike those now found to support the dorsal and anal fins of modern fishes. The caudal extremity was therefore perfectly symmetrical both externally and internally, the dorsal contribution meeting the ventral in a line continuous with the chordal axis. Such a type of caudal fin is referred to as 'protocercal.'

Embryology is not of much assistance in verifying the exact details of skeletal structure in the primitive caudal fin, for modifications of this primitively symmetrical type set in very early before skeletal elements are properly laid down. Yet it is reasonable to suppose that no specializations were present in the primitive caudal fin ; the early fishes undoubtedly moved by serpentine action, undulations of the whole body producing a forward motion resembling the progress of the modern eel. Thus the posterior extremity of the body had no special demands made upon it as a propulsive organ beyond those shared by the rest of the body.

Before proceeding further it will be advisable to describe the types of caudal fin now met with among fishes. It is probably quite safe to say that no fish at the present time possesses a protocercal caudal fin ; hence any tail fins which shew perfect symmetry both externally and as regards internal skeletal supports will be secondarily symmetrical, that is gephyrocercal. When, however, it would not be safe dogmatically to assert the primary or secondary nature of caudal symmetry, it is convenient to employ a non-committal term signifying symmetry only ; diphycercal is the term which conveys such a meaning, thus protocercy will be synonymous with primitive diphycercy and gephyrocercy with secondary diphycercy.

Now undoubtedly the protocercal fin is the earliest in evolutionary order ; heterocercal forms no doubt succeeded the protocerca in the ascending scale towards the highly specialized tail fin of the Teleosts. Heterocercy is characteristic of the Elasmobranchs and the Ganoids ; it differs from protocercy in one important feature, *viz.*, that symmetry has been disturbed. In general, the asymmetry affects both the external

form and the inner skeleton, though modification of the latter may not always be very strongly marked. The ventral contribution to the caudal fin is larger than the dorsal, and in most cases markedly so, as illustrated in the Ganoids *Acipenser*, *Polyodon* and *Amia*. Associated with this, as would be expected, the skeletal supports of the ventral fin-rays are more strongly developed than those on the dorsal side.

Though often less marked in Elasmobranchs than in the Ganoids, from the base of the fin there is an upward bend of the axis which is continued to the extremity, and when centra are present, they remain distinct throughout this upwardly directed part. We thus see that the main characteristics of the heterocercal tail are (1) an enlarged ventral lobe compared with the dorsal; (2) a bending upward of the axis at its end; (3) the retention of individual centra, when present, to the end of the axis.

Turning now to the homocercal type, there can be no question as to its having succeeded directly the heterocercal form. Reference to the skeletal structure of the caudal fin of *Amia* will readily shew that this particular fin requires but slight modification to convert it into a homocercal form, for homocercy is characterized by (1) external symmetry; (2) strongly asymmetrical internal skeletal structure by which the majority of the fin-rays are always supported by ventral elements; and (3) the presence in the larval or adult stage of a urostyle which represents a much shortened axis.

The caudal fin of *Amia* has always been recognized as deserving of some special distinctive designation, and it has usually been referred to as hemi-heterocercal; however since its distinctive feature is its close approach to the homocercal form, I have elsewhere[1] proposed that a better term would be hemi-homocercal.

It is well known that the earliest fishes of the Devonian period possessed heterocercal tail fins and that diphycercal forms appeared later. Thus the evidences of embryology have been said to be at variance with those of palaeontology; it is true that the evidences mentioned do not agree, but it would seem that there is no ground for denying that the embryological data are indicative of the sequence of forms in the evolution of the caudal fin. Professor Dollo[2] in dealing with the Dipnoi recognized the difference between the embryological and palaeontological evidences and suggested a way out of the difficulty. He argues that since the caudal fins of the earliest fossil fishes found are heterocercal, and later forms diphycercal, these later forms are secondarily diphycercal, *i.e.*, gephyrocercal.

Now gephyrocercy implies the complete loss of the original caudal fin elements, a great reduction of the axis having brought this about; and also that the new tail fin is in reality the result of a "bridging over" of the gap thus produced, by the dorsal and anal fins, each having an equal share in the formation of the new fin. *Fierasfer* is the best illustration of a gephyrocercal fin; the larva is known to possess a long filamentous termination to the chordal axis, which is entirely lost in the

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[1] *Proc Zool. Soc. London*, October 1910, where most of the caudal fins mentioned in this paper are figured.

[2] The Phylogeny of the Dipnoi.

adult fish; in the adult, the dorsal and anal fins have not completely joined round the extremity and the vertebral column has exactly the appearance of having been artificially abbreviated.

It does not, however, necessarily follow that all the symmetrical forms of the tail which follow the asymmetrical have once been heterocercal and that this fin has been lost entirely to be replaced by a gephyrocercal form. It is possible that something of this nature occurred: both the later heterocercal and diphycercal forms were descendants of a primitively symmetrical (protocercal) type; at a certain period, a divergence took place, some forms adopting the heterocercal tendency, while others continued in the line of their ancestors and retained their symmetry. This may be represented by a simple diagram (fig. 1).

FIG. 1.

It should be noticed that this does not necessarily regard all diphycercal fins as protocercal; a reduction of the terminal axial elements might proceed by which the original caudal element might be eliminated and the dorsal and anal elements made to contribute to the new caudal fin. Thus the question of the symmetrical fin is left open, and the fossil diphycercal forms might be regarded either as protocercal or as gephyrocercal.

This interpretation would appear to be a perfectly natural one; an order of things which might easily have occurred, for the modification of such an organ is only the result of a change in habit; it cannot be expected that all fishes adopted the same form of locomotion in early times, since it is not likely that all adopted the same change of habit.

I have said that the development of heterocercy was due to a change of habit, and it is necessary to enquire what change was consequent on the adoption of the heterocercal caudal fin, or rather how heterocercy could bring about any change. An explanation is not easy even if possible. In this connection we may recall Ryder's theory of the use of heterocercy; he likens the use of the tail fin to the sculling action of the boatman, who propels his boat by a side to side motion of a single oar from the hinder end. The analogy is a good one and explains the use of the tail as a propeller, but it still leaves it uncertain why the axis turned upward and not downward; why the ventral side was chosen for enlargement and not the dorsal. It is a question mainly for the physicist to answer, and innumerable enquiries I have addressed on the point to physicists have all failed to obtain an answer.

It is thought that early fishes were bottom dwellers, and that in the attempt to explore the upper waters there was a mechanical stimulus, the response to which caused the ventral lobe to increase in order to cope with the demand made upon it. The rearing of the trunk to reach

upward, causing a bend in the body convex to the bottom, would be accompanied by a lash of the tail; it would be an advantage to have the propelling force more or less in line with the anterior end of the body, and thus the ventral side of the caudal fin would have a greater demand made upon it than the dorsal.

If the fish is represented as rising from the bottom by the bent arrow in the diagram (fig. 2), the broken line will indicate the posterior continuation of the line of progress after the tail has completed a lash; the dotted lines would represent the form of fin useful for this purpose. This is merely a suggestion put forward until a better one is forthcoming, but correct or no mechanically, certain it is that all fishes with heterocercal tendencies developed the lower lobe of the caudal fin and never the upper.

FIG. 2.

Having discussed the probable stimulus effecting heterocercy, there still remains the question as to why it was at all necessary to develop this asymmetry. When we remember that heterocercy is but a stage in the production of homocercy, it is clear that external symmetry was the ideal to be reached; why then was the symmetry of protocercy abandoned only to be again attained? Again the answer is one of mechanics; had the protocercal form been merely expanded, the internal skeletal supports of this fin could not have met the demand made upon them. The epural and hypural elements would have been long and practically parallel with the axis; this in itself would not have been mechanically strong. Moreover, the centre of the caudal fin would have been weak, there being no direct support for the fin-rays in the middle line, and it is here that strength is most needed. An essential, therefore, for a strong caudal fin is a firm support for the dermotrichia forming the greater part of the fin especially near the centre.

It is in the final product of homocercy that one must look for an interpretation of the meaning of heterocercy. The examination of such a caudal fin as that of *Scomber*, well known as one of the fastest of swimmers, shews how the result has been attained; the upturned axis provides the supports of the fin-rays with a firm attachment, and the supports are seen to radiate from a centre which is in line with that of the axis. In the majority of Teleosts the hypurals, which always support the greater number, and sometimes even the whole of the caudal fin-rays, are firmly fused to the vertebral elements. It will therefore be seen that the reason for the heterocercal stage is that the ventral fin-ray supports may be brought into the same line as that of the axis, and at the same time afford a strong attachment for them. It was the only way these ends could be achieved; symmetry had to be abandoned

during heterocercy in order again to restore an external symmetry of a more efficient type.

There is still another morphological question that the above evolutionary process involves. What is the true nature of the homocercal caudal fin? Is it a true modified caudal or is it an anal fin which has come to occupy a relatively posterior position? If we examine almost any heterocercal caudal fin, such as that of *Acipenser* or *Polyodon*, we see that the greater part of the fin is supported by hypurals some considerable distance from the end of the chordal axis. Should the axis again be straightened, this portion would certainly be regarded as anal fin from its very position. That the vertebral axis of Teleosts, and it may be of all fishes, has been very much reduced in length is certain; the continuation of the spinal cord beyond the last centrum is sufficient proof of this, and with this reduction the original caudal rays have gone too, unless a few dorsal rays associated with the opisthure are the last remnants. The upturning of the chorda therefore almost certainly involved the bringing of a more anterior fin, an anal, into a relatively posterior terminal position.

The question as to whether separate median fins had been yet differentiated need not seriously affect this view, for during development it can be seen that the skeletal elements of the differentiated fins are laid down before heterocercy sets in, and thus differentiated fins might be regarded as having been established during the protocercal condition in some cases at least. Differentiation, however, may not have been developed in all cases, and then it is only a matter of extended growth of a part of a continuous fin. Thus this question is not one of primary importance since certainly dorsal, caudal and anal fins are only names for portions of a once continuous series.

The supporting elements for the caudal dermotrichia are of three kinds: firstly hypurals; secondly epurals; and thirdly radials, either dorsal or ventral. These terms are here used according to the definitions given by me in an earlier work,[1] and it may be useful to quote them briefly. A hypural is defined as any hypaxial element having direct connection with the chordal axis, and bearing one or more caudal fin-rays distally; an epural is the corresponding epaxial element; a radial is synonymous with 'somactid' and 'interspinous bone.'

One constantly sees statements which refer to hypurals as haemal arches; Sedgwick writes[2] "In all fishes the ventral part of the caudal differs from the other median fins in the fact that the dermotrichia (fin-rays) are supported directly by the haemal arches." Such a reference is typical of text-books in general concerning caudal fins, but the matter is one deserving of discussion. As far back as 1854 Stannius in his text-book on the Vertebrata clearly stated that the fin-ray supports were compound structures, consisting of arch and radial combined. Ryder[3] in 1884 seems to have come to the same conclusion but this interpretation seems to have been ignored in more recent works.

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[1] Loc. cit.

[2] *Students' Textbook of Zoology*, 1905.

[3] "Evolution of the Fins of Fishes," *Rep. Comm. Fish and Fisheries*, Washington, 1884, published 1886.

Before entering into the question, I would again draw attention to the presence of independent radials as supports of caudal fin-rays. Dorsal caudal radials as I have called them are usually present, and are the bones referred to by Huxley[1] as epurals; ventral caudal radials are also frequently present though much less than their corresponding dorsal homologues. In all Gadidae, *Solea, Zeus, Gobius* and others, radials persist ventrally.

Now since radials are the normal supports of the dermotrichia in other median fins, we may assume that they once were in the caudal, which is merely a part of the same system. Haemal arches, therefore, cannot be regarded as the original supports of fin-rays, and if they are considered to have taken over this function, they must be regarded as having lengthened and expanded distally with a view effectively to fulfil their new function. On the other hand, radials are the natural supports of fin-rays. It is also interesting to notice which of the two elements, radials and arches, are the more persistent when subjected to eliminating influences. The flexion of the extremity of the chorda affected the dorsal and ventral side of the fin differently; epaxial elements had less room assigned to them, while the hypaxial structures were afforded scope for extended development. The response to this influence is very marked; on the ventral side fin-ray supports have expanded to fill the widening cleft between them, but dorsally suppression has resulted. But which structures dorsally have succumbed to this crowding-out process? Not the radials but the neural arches; as long as dorsal fin-rays remain to be supported, the radials retain their function, while neural arches have disappeared or been reduced. We are forced therefore to regard radials as more persistent than arches.

When the caudal fin became a definitely propulsive organ, more rigid support was required for the fin-rays; to accomplish this there were clearly two ways open; (1) by the transference of the supporting function from radials to haemal spines, and (2) by the mere fusion of the radials with the haemal spines. The first alternative involves, one might almost say, a preconceived purpose on the part of the spines to acquire a new function; they must lengthen, expand and, in so doing, eliminate structures already performing the work they are to take over. Such a change of function is usually accompanied by a stimulus, in response to which the change takes place; but it is difficult to see what stimulus could have been applied to the haemal arches to initiate a change. The radials clearly had a stimulus, a mechanical one, and one cannot avoid concluding that they responded thereto, thus obtaining as it were a start on any other competitor.

It has been shewn that radials are more persistent than arches dorsally; is it likely therefore that in a region where extended scope for development is afforded, as is the case ventrally, that structures already well adapted for the support of fin-rays, and indeed actually fulfilling that rôle, should abandon their function in favour of structures in no way so fitted, especially when, under adverse conditions, as dorsally, they tenaciously retain that function? It is inconceivable, and one is tempted to ask what would happen during the period of transference.

[1] "On Some Parts of the Skeleton of Fishes," *Q. J. M. S.*, 1859

It is far easier to conceive of the very simple process of fusion of radial with the rigidly attached haemal spine, for this is exactly what would be expected. Without labouring the theoretical aspect further, it may be mentioned that there is abundant evidence among Teleostean fishes, as well as Elasmobranchs and Ganoids that such fusion has occurred; the following examples may be quoted as affording evidence: *Acanthias, Galeus, Heterodontus, Acipenser, Polyodon, Synodontis, Plotosus, Anguilla, Conger, Gadus, Gadiculus, Molva, Motella, Centriscus, Belone* (Stannius' example), *Box, Zeus,* and *Pleuronectes.* In all these cases the line of fusion between arch and radial can still be seen.

There is, however, another aspect worth mentioning; it has been maintained that radials are derived in the first place from neural and haemal arches by segmentation, a view which receives support from the Dipnoi, where the radials rest directly upon the spines. But the most favoured opinion does not lend support to this view since, except for the caudal, in the median fins of Elasmobranchs radials are so far removed from the axis. Were this segmentation theory correct, it might have been argued that the caudal region retains the primitive condition, but in this connection the presence of radials in the caudal fin would present a difficulty. Thus the study of the caudal fin-structure entirely supports the view that radials are elements developed independently of the axial structures.

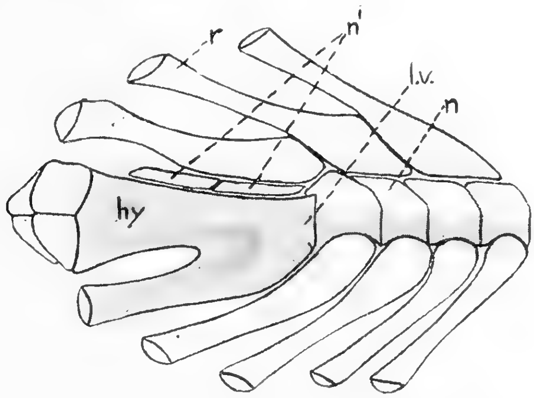

FIG. 3.—Caudal extremity of *Torpedo ocellata.*

hy., hypural; l.v., last centrum; n., neural arch; n'., neural arches of centra now suppressed; r., radial.

In concluding these remarks on homocercy, I would like to refer to the internal structure of the caudal fin of the electric torpedo, *Torpedo ocellata* (fig. 3); this fin has never to my knowledge been previously described, and I have refrained from discussing it earlier, because material has not been available to allow me to examine more than a single specimen. But even if this particular specimen was abnormal, which I doubt, it certainly is extremely useful in shewing that tendencies to the homocercal type may occur among the Elasmobranchs; indeed more than mere tendencies, in fact a homocercy which, had it been found in the Teleostei, would not have been considered strange.

The specimen was dissected by me some years ago and I believe affords the only instance of homocercy yet recorded among the Elasmo-

branchs. As is well known, the external form of the tail fin of *Torpedo* is symmetrical; internally, however, the ventral fin-rays are directly borne by hypurals, the two terminal ones being strongly developed, fused at their bases both to one another and to the last centrum. Above the last hypural are to be seen the remains of the neural arches of vanished centra, occasioned by the abbreviation of the vertebral column; they are still to be found because they are necessary to provide protection for the terminal portion of the spinal cord. All the ventral supports are hypurals, while dorsally the rays are borne exclusively by radials which have not fused with the neural arches.

It is possible that an investigation into the tail fin of the Rays may prove to be of considerable value; while *Torpedo* thus possesses what may be regarded as a fairly specialized type of homocercy, others may shew a simpler tendency in that direction.

XVII. STUDIES ON THE ANATOMY OF INDIAN MOLLUSCA.

2. THE MARSUPIUM AND GLOCHIDIUM OF SOME UNIONIDAE AND ON THE INDIAN SPECIES HITHERTO ASSIGNED TO THE GENUS *NODULARIA*.

By B. PRASHAD, *D.Sc., Superintendent of Fisheries, Bengal, Bihar and Orissa, Calcutta.* (*Communicated by permission of the Director of Fisheries, Bengal.*)

(With text-figures 1—3.)

In part one[1] of this series I described the structure of the marsupium and the glochidium of two species of the genus *Physunio*, Simpson. The present communication consists of two parts, the first of which deals with the same structures in two of the common genera of Indian Unionidae, *Lamellidens*, Simpson, and *Parreysia*, Conrad, while in the second an account of the soft parts of the animal of an Indian genus hitherto confounded with the genus *Nodularia*, Conrad, is given. A new generic name, *Indonaia* is, therefore, proposed for the Indian species. An account of the structure of the glochidium of two of the species of this genus is also included. Further, a few records of the occurrence of encysted glochidia on the fins of some Indian fishes are given.

A full histological account of the structure of the gills in these genera is not included as I hope to come to this subject later and to deal with the Indian Unionidae as a whole.

The material for this investigation consists of a collection made by Babu D. N. Sen, Zoological Assistant, Bengal Fisheries Department, and the various collections made on different occasions by the officers of the Zoological Survey of India; these latter collections were very kindly placed at my disposal by the Director of the Zoological Survey of India.

I have also to express my indebtedness to Mr. T. Southwell, the Director of Fisheries, for the kind encouragement and the generous way in which he has met with my wishes at all times. To Babu D. N. Sen my thanks are due for the careful records of locality, preservation of specimens and willing help whilst working with me in the Fisheries Laboratory.

GENERAL.

The marsupium is of very great importance in the classification and natural grouping of the genera of the Unionidae, but unfortunately at the time of Simpson's[2] revision the anatomy of the Indian genera was not known in most cases. He, however, from a

[1] *Rec. Ind. Mus.* XV, p. 183-185, pl. xxii (1918).
[2] *Proc. U. S. Nat. Mus.* XXII, p. 501-1075 (1900).

study of the shell characters alone, placed the genera in the groups established by him primarily on the structure of the marsupium. This tentative classification has necessarily proved to be wrong in many cases. It was shown in the first paper of this series, that the genus *Physunio* should be placed in the sub-group Mesogenae of the group Exobranchiae and not in the Endobranchiae as was done by Simpson. As a result of my investigations on three of the commoner Indian genera, it has been found that these also have been assigned wrong places. *Lamellidens* and *Parreyssia* were placed in the sub-family Hyrinae, which are, according to Simpson, primitive forms, and carry the glochidia in the inner pair of gills (Endobranchiae) Preston in the official " Fauna of British India "[1] has followed Simpson, *loc. cit.*, adding nothing new so far as the anatomy was concerned, and even neglected the various important contributions on the anatomy of some of the Indian Unionidae published since Simpson's revision was issued. These observations of mine are, in part, a confirmation of what was found by Ortmann[2] as a result of his study of the animals of *Parreyssia wynegungaënsis* (Lea) and *Lamellidens consobrinus*, Lea. Preston on page 180 of the volume cited above considers the latter to be only a subspecies of *Lamellidens marginalis* (Lamarck). Ortmann found that the position assigned by Simpson to the genera *Parreyssia* and *Lamellidens* was quite wrong. Both these genera were, from the structure of the marsupium, found to be exobranchous, and in his revision he placed them in the sub-family Unioninae of the family Unionidae. This sub-family he characterised as having the " Marsupium formed by all four gills or by the outer gills only ; edge of marsupium always sharp and not distending ; water-tubes not divided in the gravid female." Unfortunately the material which Ortmann had at his disposal was very small and consisted of sterile or unripe females from Bombay.

In the case of the third genus *Nodularia*, Conrad, it was found that in the two Indian species investigated the animal was quite different from that of *N. aequitaria* (Morelet), and *N. japanensis* (Lea), and that the Indian forms of this genus unlike the Japanese and the African endobranchous forms should be placed in the Exobranchiae. This subject is treated in detail further on in the account of the genus, which has for this reason been separated from the genus *Nodularia* and called *Indonaia*.

Lamellidens.

Two varieties of the common Indian species *L. marginalis* (Lamarck) were studied. The first is a variety very little different from the typical form and may for the purpose of the present paper be considered as such. The nomenclature of the varieties and subspecies of *L. marginalis* is in a very confused condition. Gravid specimens of this form were collected in a tank at Bora near Serampur in the Hughly district, Bengal, on the 1st of April, 1918. The outer pair of gills, which alone formed the marsupium, were found to contain large numbers of unripe glochidia. Specimens were kept in large bowls in muddy water, but no further

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1 *Mollusca, Gastropoda and Pelecypoda*, p. 134 (1915).

2 *Ann. Carnegie Mus.* VIII, pp. 222-365, pls. xviii-xx (1911-12).

development took place. In the other variety *obesa* (H. and T.) also only the outer pair of gills serve as the marsupium. I have found by a study of sections of the gills of males, gravid and sterile females that the differences in the structure of the respiratory and marsupial gills, originally described by Peck[1] for the gills of *Anodonta* and later on found by Ortmann[2] to be constant in a large number of other genera as well, are the same in *Lamellidens* and *Parreyssia*, and so need not be detailed here. In the marsupial gills the inter-lamellar junctions are more numerous than in the respiratory gills, the epithelial covering of the lamellar junctions is modified ; whereas in the purely respiratory gills of the female and those of the male the inter-lamellar junctions are fewer and the epithelial covering is of the ordinary type. As expected by Ortmann the gills do not swell very much when full of glochidia and their lower margins are always sharp and distended. In the first variety no glochidia were found but the embryos were found to be agglutinated together to form a flat more or less elliptic plate, thick and broad above, thin and tapering below.

The glochidia of the second variety *obesa* (H. and T.) may be described as semi-elliptic (fig. 1*a*) with a rounded ventral margin, the hinge-line rather long and nearly straight and measuring ·248 mm. by ·210 mm.

Parreyssia.

The number of species and varieties of this genus which was studied was much larger than of the others. In the following table I give the locality, date on which collected, the gills in which the glochidia were found and the size of the glochidia. It is of interest to note that the specimens were from such widely separate localities as Eastern Bengal, Chota Nagpur and the Western Ghats in the Bombay Presidency. One of the forms which I have marked with a query seems to be either an undescribed variety of *P. favidens*, or possibly a distinct species.

Name.	Locality.	Date of collection.	Gills with glochidia.	Size of glochidia.
P. favidens (Benson)	Mirpur, E. Bengal.	1st week of June, 1917.	All four gills .	·210 mm. × ·153 mm. (fig. 1*b*).
P. favidens var ? .	Do. .	Do. .	Right inner gill .	·190 mm. × ·073 mm. (fig. 1*c*).
P. favidens var. *assamensis*, Preston.	Do. .	Do. .	Inner pair of gills .	·172 mm. × ·142 mm. (fig. 1*d*).
P. favidens var. *tripartitus* (Lea).	Do. .	Do. .	All four gills with embryos.	?
P. favidens var. *viridula* (Benson).	Chakradharpur, Chota Nagpur.	3rd February, 1918.	All four gills .	·229 mm. × ·190 mm. (fig. 1*e*).
P. corrugata (Müller)	Medha, Bombay Presidency.	27th February, 1918.	Do. .	·191 mm. × ·159 mm. (fig. 1*f*).
P. corrugata var. *nagpoorensis* (Lea).	Mirpur, E. Bengal.	1st week of June, 1917.	Outer left full, outer right with a few only.	·174 mm. × ·153 mm. (fig. 1*g*).

[1] *Q. J. Microsc. Sci.* XVII, pp. 43-66 (1877).
[2] *Mem. Carnegie Mus.* IV, pp. 279-347, pls. lxxxvi-lxxxix (1911).

Though the glochidia were not found in all cases to fill up all the four gills, yet in *P. favidens* var. *tripartitus* all the four gills were full of embryos, and in the typical form of *favidens*, *P. favidens* var. *viridula*, and *P. corrugata* all the four gills contained glochidia. In the other varieties the structure of all the four gills was modified for a marsupial function and the absence of glochidia in some of the gills seems to be due to their having been shed before the specimens were collected.

The structure of the gills and the water-tubes is very similar to that in the genus *Lamellidens* described above.

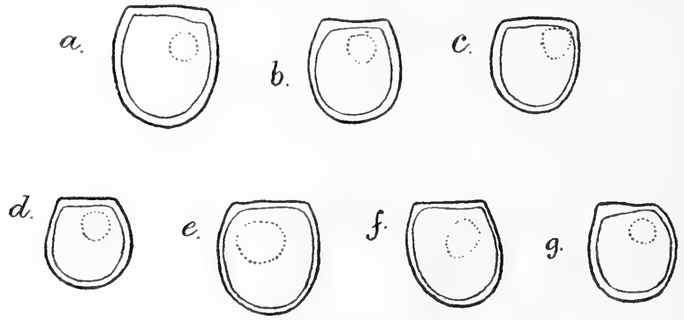

Fig. 1.

Glochidia of (a) *L. marginalis* var. *obesa*, (b) *P. favidens*, (c) *P. favidens* var. ? (d) *P. favidens* var. *assamensis*, (e) *P. favidens* var. *viridula*, (f) *P. corrugata*, (g) *P. corrugata* var. *nagpoorensis*.

The glochidia, as will be seen from the figures (fig. 1 *b—g*), all of which are drawn magnified 75 times, are semi-circular or semi-elliptic. In their structure, sculpture of the shell and the nature of the flange on the inner and lower surface of the shells they are quite like those of the genus *Physunio* described in my paper, *loc cit.*

Indonaia, gen. nov.

Simpson in the paper cited above included in the genus *Nodularia*, Conrad, a number of groups of shells of such wide range as Japan, China, Siam, India and Africa. The anatomy of some of the members was known, but the others like the Indian forms were included because of the shells having a close resemblance to those of the genus *Nodularia*. Haas[1] in his account of the genus *Nodularia* included only the species found in Siam, Cambodia, Annam, China, the Amur region, Korea and Japan, apparently considering the Indian species to belong to a distinct genus. As a result of my investigations of the soft parts of the animals of some of the Indian species, it was found that these species had no relationships with those that properly belong to the genus. Whereas the species *N. japanensis* (Lea), a Japanese form, and *N. aequitoria* (Morelet), an African one, carry the glochidia in the inner pair of gills (endobranchiae) and belong to the sub-family Hyrinae of the family

[1] Martini und Chemitz, *Conch. Cab.*, (*ed. Kuster*) IX, Abth. 2, pt. 2, Die Unioniden (1910).

Unionidae of Simpson; the Indian species investigated carry the glochidia in all the four gills (endobranchiae), and will have to be placed in the sub-family Unioninae of Simpson or according to the later classification of Ortmann[1] in the restricted sub-family Unioninae, Ortmann. None of the older names being available, the generic name *Indonaia* is proposed for the Indian species with *Unio caeruleus*, Lea, as its type. I have as yet been able to examine the animals of *I. caerulea*, *I. caerulea* var. *gaudichaudi*, *I. pachysoma* and *I. pugio*. In these the description of the soft parts given below was found to be constant. It is to be expected that the structure of the animal in the other Indian species, hitherto assigned to the genus *Nodularia*, would be similar, and the genus *Indonaia* would therefore include all the species described by Preston, *loc. cit.*, pp. 135-146.

I have nothing to add to the following description of the shell given by Simpson for the group of *N. caerulea*, "shell elliptical, inflated, pointed about midway up behind, the post basal region produced, with a well developed posterior ridge; beaks sculptured with numerous fine, radiating riblets, the central ones of which join below, the whole often more or less zigzagged, and extending well over the disk; epidermis generally bluish-green."

The animal (fig. 2) may be described as having the inner gills much wider than the outer both in front and behind. The inner lamellae of the inner gills are not free but united with the abdominal sac throughout and with each other behind to the end. The palpi are rather large;

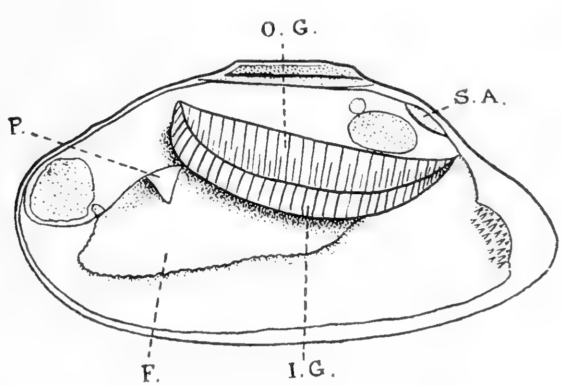

Fig. 2.

Animal of *Indonaia caerulea* var. *gaudichaudi*. *F.*=foot, *I. G.*=Inner gill, *O. G.*=Outer gill, *P.*=Palp, *S. A.*=supra-anal opening.

the mantle has the margin simple and not toothed; the branchial opening is large with three to four rows of pointed papillae; the anal opening smaller than the branchial of a light brown colour without any tubercles; the supra-anal opening separated from the anal by a distinct mantle connection which is rather short. The supra-anal opening itself is

[1] *Ann. Carnegie Mus.* VIII, pp. 223-224 (1911-12).

smaller than the anal and of a brownish colour. The glochidia are carried in all the four gills.

The glochidia are nearly ovoid, with a very small, straight hinge-line and a small hook on each shell (figs. 3 *a-c*). Gravid specimens of two species were obtained, *I. caerulea* var. *gaudichaudi* and *I. pachysoma.* Females of *I. pachysoma* were collected on the 14th of January 1912, in a lake nine miles from Berhampur, Bengal; the glochidia (fig. 3

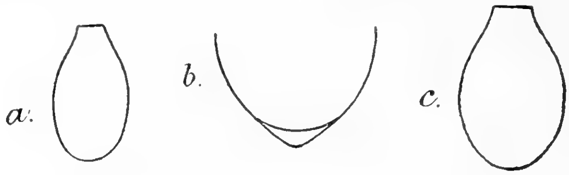

Fig. 3.

Glochidia of (*a*) *I. pachysoma*, side view. (*b*) Inner view of the lower portion of the shell of the glochidium of *I. pachysoma*, showing the hook. (*c*) Glochidium of *I. caerulea* var. *gaudichaudi.*

a, b) are ·248 mm. by ·115 mm. in size. The specimens of *I. caerulea* var. *gaudichaudi* were collected on the 1st of April 1918, from a pond four miles from Serampur, in the District of Hughly, Bengal. The glochidia (fig. 3*c*) measure ·289 mm. by ·182 mm.; they are of the same type as that of *I. pachysoma* except that they are bigger.

The glochidia of this genus are very different from those of the other known Indian genera. They differ in shape and show a distinct advance in that the flange on the lower margin of the shell of each side is becoming more highly evolved and is restricted to a hook in the centre.

Fish hosts.

In this section I do not attempt at any specific identification of the glochidia, which were found encysted on the fins of a large collection of fishes from the Satara and Poona districts of the Bombay Presidency. The localities and the conditions under which these fishes were collected are fully discussed by Dr. Annandale in the systematic account of these fishes to be published shortly in the "*Records*," and I need no more than give a list of the various species which were found to have glochidia on their fins.

Nemachilus savona (Ham. Buch.).
Nemachilus anguilla, Annandale.
Psilorhynchus tentaculatus, Annandale.
Cirrhina reba (Ham. Buch.).
Barbus malabaricus, Jerdon.
Barbus jerdoni, Day.
Barbus ticto, Day.
Rasbora daniconius (Ham. Buch.).
Danio aequipinnatus (McCl.).
Chela boopis, Day.
Ophiocephalus gachua (Ham. Buch.).
Gobius bombayensis, Annandale.

XVIII. NEW SPECIES OF SLUG-LIKE MOLLUSCS BELONGING TO THE FAMILY ZONITIDAE FROM THE DAWNA HILLS, TENASSERIM, COLLECTED BY Dr. F. H. GRAVELY.

By Lieut.-Colonel H. H. Godwin-Austen, *F.R.S.*

(Plate XVIII.)

So long ago as 1912 I received a collection of shells made in the winter of 1911 in the Amherst District, Tenasserim, by Dr. F. H. Gravely of the Indian Museum, Calcutta. Undoubtedly the most interesting new species obtained are those I now describe, slug-like forms belonging to the genera *Austenia* and *Girasia*. I am much indebted to Dr. Gravely for seeing them, and I have much pleasure in naming one *Girasia* after its discoverer. Unfortunately there are few examples to deal with, and I have hesitated to cut up type specimens to see the internal anatomy. It is, I know, very difficult at certain seasons to find many specimens of these molluscs ; if it be possible 6 at least should be collected, the whole anatomy can then be seen and a couple reserved for the Museum.

The photographs have been made by my friend Mr. J. S. Gladstone, they are very good and my best thanks are due to him.

These and allied genera are very abundant at the wettest season of the year, but with diligent search under stones and logs of wood they may be found at any time. Their preservation in alcohol is a difficulty and the collector must be prepared to face leeches and malaria. From the malacological point of view they form a most interesting group. Their exact distribution specifically is little known. Take for instance *Girasia peguensis*, Theobold.[1] Nothing is known of those inhabiting Hill Tipperah, the Chin Hills, Northern Burma and the Shan States, this large forest-clad area would yield many many species, probably even new genera.

This paper would have been published before now, but the large Abor collection took up much of my time. The times besides have been against and affected work of this kind.

Girasia ? sukliensis, n. sp.

(Pl. XVIII, figs. 1—3.)

Locality.—Sukli, Dawna Hills, 900-2,300 ft., Tenasserim, November, 1911 (*F. H. Gravely*).

Shell extremely thin, filmy and undeveloped ; colour near the rounded apex white, rest pale green.

Size.—Major diameter about 9 mm.

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[1] *Moll. India*, vol. I, p. 227, pl. lix, figs. 6, 6*a*, 6*b* animal, 6*c*, 6*d* shell.

Animal (figs. 1 and 2).—About 26 mm. in length, contracted, pale grey in colour, with rather large scattered spots of black with smaller spots along the peripodial margin ; mantle and head dark grey.

The side of the foot has a papillate surface, the oblique grooves from the margin close and distinct ; foot sharply keeled up to the depression in which the shell rests, square at extremity, the mucous gland being a very narrow slit. Sole of the foot narrow with a well marked central area, bordered on each side by a very finely segmented one.

Right shell lobe very small, oblong, narrow, rounded at the posterior end. Cicatrical line well marked. Left shell lobe broadly covering the edge of the peristome. Right dorsal lobe small, the left large, spreading over the neck and round to the left posterior side, thus similar to *G. peguensis* (fig. 3).

The visceral sac extends far back to near the extremity of the foot. The short oesophagus passes into a very capacious stomach and then continues into the lobes of the liver. The generative organs were atrophied, but sufficiently developed to show they are like those of *Girasia*. Only the amatorial organ was conspicuous.

Girasia gravelyi, n. sp.

(Pl. XVIII, figs. 7, 8.)

Locality.—Sukli, Dawna Hills (east side), Tenasserim (*F. H. Gravely*).

Shell polished, shiny ; apex very small, with the very slightest sign of a coil.

Size.—Major diameter 10 mm.

Animal (figs. 7 and 8).—Length contracted in alcohol 28 mm., of a general dark grey colour with distinct irregular blackish spots on the side of the foot, peripodial (the fringed) margin narrow with two grooves above, its segmentation fine, and this applies to the foot above, the usual oblique grooves being indistinct and close together with the surface broken up into minute quadrate and pentacular areas, becoming almost papillate. The foot behind is square to the sole, with a slit-like mucous gland, it is sharply keeled up to the depression in which the shell and visceral sac rests. The sole of the foot has a central area, but is not crossed by segmental grooves. The mantle is very dark, rather smooth ; a distinct cicatrix proceeds from the respiratory orifice upwards and backwards separating the narrow oblong right shell lobe, its rounded end just covering the anterior margin of the shell. The dividing line between these shell lobes and the right dorsal and left dorsal lobes is well seen.

In its general form this species comes nearest to *G. sikkimensis,* G.-A., *Moll. Ind.*, Vol. 1, p. 239, plate lix, figs. 2-2*a* (animal), 2*b* (shell).

Austenia dawnaensis, n. sp.

(Pl. XVIII, figs. 4–6.)

Locality.—Dawna Hills (west base), at 1,400 ft., only one specimen (*F. H. Gravely*).

Shell spatulate, coil of apex fine; sculpture none, surface smooth and shining; colour ochraceous with a green tinge; suture short impressed; whorls 1½.

Size.—Major diameter 15·5; minor diameter 9·5 mm.

Animal (figs. 4 and 5).—Spirit specimen much contracted, 39 mm. in length. Two peripodal grooves lie above the edge of the foot, the area between them regularly segmented, the segments of the fringed margin extending beneath the foot, but do not cross the median area of the sole of the foot.

Mucous gland a narrow slit, nearly vertical and very slightly overhanging above, extremity of foot keeled for a short distance, then rounded as it approaches the shell, the apical part of which rests in a depression. Regular segmental grooves becoming close-set extend from the irregular upper peripodial groove to the keel.

The right shell lobe is very small, the left extends all round the peristome as a narrow band, leaving much of the shell exposed, a short cicatrix divides them running to the respiratory orifice; the right dorsal lobe is small, the left is very broad and ample up to the posterior margin.

The frontal side of the animal (fig. 6), although much contracted, gives an interesting view of the mouth, and shows the segmented sides of the foot and its plain central area.

Austenia ? dawnaensis, young.

Locality.—Dawna Hills, Tenasserim (*F. H. Gravely*).

Shell broken by sudden contraction in the spirit, very thin and spatulate.

Size.—Major diameter 13·0 mm.

Animal.—Pale coloured, dark on head and neck, and darkish on the forepart of the mantle.

The margin of the foot is fringed, but the usual grooves above it cannot be discerned, in fact the whole body is quite smooth, from some change, probably after being put into alcohol. Sole of foot similarly quite plain.

There is a small right shell lobe, while the left shell lobe overlaps the edge of the peristome right round from the respiratory orifice to the left side. The right dorsal lobe is very small, the left very ample. The extremity of the foot is truncate, the mucous gland a narrow slit.

This specimen may be compared with *A. dawnaensis* (No. 6063) in its general external characters and may possibly be a young specimen.

EXPLANATION OF PLATE XVIII.

FIG. 1.—*Girasia sukliensis*, n. sp., view of right side. × 2.

,, 2. ,, ,, ,, view of dorsal side. × 2.

,, 3. ,, ,, ,, mantle seen from above, with visceral sac, shell removed. × 4·5.

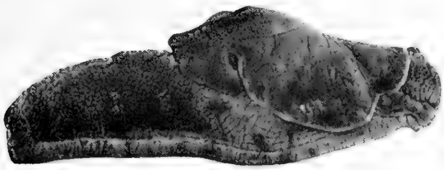
,, 4.—*Austenia dawnaensis*, n. sp., view of right side. × 1·5.

,, 5.— ,, ,, ,, view of dorsal side. × 1·5.

,, 6.— ,, ,, ,, view of frontal side. × 3·25.

,, 7.—*Girasia gravelyi*, n. sp., view of right side. × 2.

,, 8.— ,, ,, ,, view of dorsal side. × 2.



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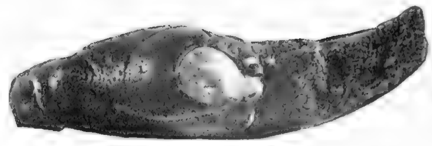

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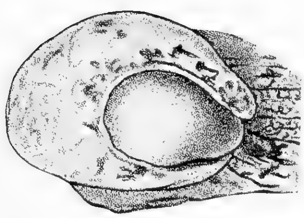

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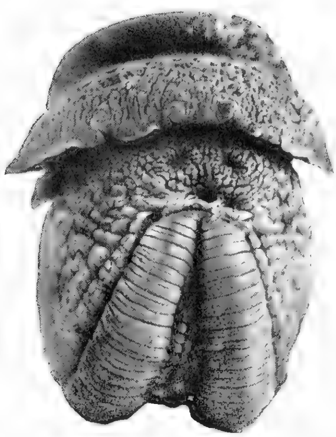

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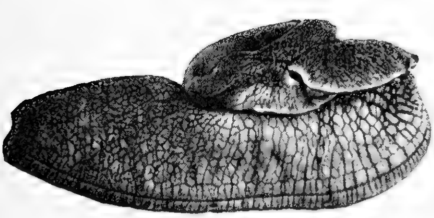

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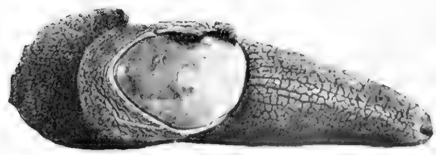

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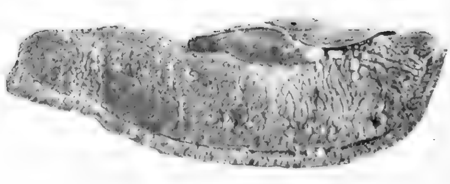

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Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1918.

XIX. CONTRIBUTIONS TO THE ANATOMY OF AQUATIC DIPTERA.

1. LARVAL AND PUPAL STAGES OF AN INDIAN *CHAOBORUS* AND *DIXA*.

By BAINI PRASHAD, *D.Sc., Superintendent of Fisheries, Bengal Fisheries Laboratory, Indian Museum, Calcutta.* (*Communicated by permission of the Director of Fisheries, Bengal.*)

(With Plate XIX.)

In a previous communication [1] I described the anatomy of an Indian Chironomid larva of the genus *Polypedilum*. The present paper deals with the larval and pupal stages of two other Nematocera—*Chaoborus* and *Dixa*. It is hoped that it may be followed by others on various aquatic Diptera, our knowledge of the Indian forms being in a very unsatisfactory condition. Most of the material for the present investigation was put at my disposal by the Director of the Zoological Survey of India; some I had collected myself.

The larvae and pupae of the Corethrid *Chaoborus* were collected by Dr. Annandale in the *Limnocnida* pool in the river Yenna, at Medha in the Satara district, Bombay Presidency, during the first week of March, 1918; the material was well preserved, and both larvae and pupae were found in abundance. Besides this I had a large number of larvae collected in the third week of April, 1912, at the same place by Dr. F. H. Gravely. No pupae were obtained on this occasion, though larvae were abundant. I also had for comparison a single specimen collected by myself in a shady pool in the Lawrence Gardens, Lahore, in the month of November, 1916; observations were made on this living larva whilst it was kept in a small aquarium in the Zoological Laboratory of the Government College, Lahore, for a period of over two months; the larva even after this long period did not pupate and was preserved in formalin. A few remarks about the name of the fly to which the larvae and pupae belong would not be out of place here. Giles[2] in 1910 described the fly as *Corethra asiatica* as a new species from Shahjahanpur, and it was referred to as such by Theobald.[3] Edwards, however, has recently [4] shown that the form is specifically identical with the one described by Schiner in 1868 as *Corethra manilensis* (*Reise Novara, Diptera*, p. 30). Further, the species does not belong to the genus *Corethra* as now restricted, but is a *Chaoborus*. The name of the fly must, therefore, be *Chaoborus manilensis* (Schiner).

The larvae and pupae of *Dixa* were collected by Major S. R. Christophers, I.M.S., from the hill streams at Kasauli in February, 1914. A large number of flies was reared by him, and the whole collection of

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1 *Rec. Ind. Mus.*, XIV, pp. 71-74, pl. xxiii (1918).
2 *Journ. Bombay Nat. Hist. Soc.*, XIII, p. 610 (1910).
3 *Genera Insectorum, Diptera*, p. 43 (1905).
4 *Bull. Ent. Res.*, IV, p. 242 (1913-14).

larvae, pupae and flies presented to the Indian Museum, Calcutta. The fly has been identified as *Dixa montana*, Brun., by Dr. Annandale after comparison with the type-specimen. Mrs. Adie [1] has recorded the finding of a large number of larvae of a species of *Dixa*, in a pond in the Lawrence Gardens, Lahore. On many occasions I tried in the same place to obtain specimens but without success.

LARVA OF *CHAOBORUS MANILENSIS*.

The larvae at Medha were found in seven to twelve metres of water, over a hard rock bottom covered with a thin layer of vegetable débris and fine gravel, the water was muddy and opaque, and a slight trickle of water was running in and out of the pool. The pond at Lahore is an artificial one, overhung by large trees, and is about twenty feet across and three to five feet deep; it is full of dead leaves and the water is of a muddy darkish colour; it is every now and then replenished from a canal.

Observations made on the living larva at Lahore showed that its habits are identical with those of the European species described by Miall.[2] It may be mentioned, however, that those described by him (*op. cit.*) and by Wiesmann[3] as *Corethra* belong, like the form considered in this paper, to the genus *Chaoborus*, Lichtenstein. The larva of the genus *Corethra*, Meigen, is quite distinct, and is what is described by Miall on page 121, as the larva of *Monochlys*. Very good figures of the larvae of *Chaoborus* and *Corethra* are given by Howard, Dyar and Knab.[4]

The full grown larvae are 7—8 mm. long. When living they are transparent with the four air-sacs opaque and coppery. The alimentary canal has a faint reddish tinge, especially in the middle region of the abdomen. In older larvae the mass below the abdomen was tinged with orange. The preserved specimens are milky white, the air-sacs brownish black, the head round the eyes dark brown, elsewhere of the same colour as the body; the eyes themselves are of a dense black colour. The division of the body into head, thorax and abdomen is very distinct; the neck is very small and in many specimens, owing to the head being drawn underneath the thorax, cannot be seen. The *head* is a very small structure, narrower than any of the body segments except the last abdominal. Seen in a side view it is more or less triangular, while in a dorsal view the basal part appears quadrangular with the eyes at the anterior angles. The anterior part of the clypeus is of the shape of a very much elongated and vertically flattened process, with the extremity of which the antennae are articulated; there being no preantennal portion of the head. On the ventral side a little behind the point of attachment of the antennae there is a large bunch of setae hanging down from the vertical process of the clypeus mentioned above. Behind the group of setae there are two elongated triangular flaps attached to the same process; these flaps are mobile and have their pos-

[1] Patton and Cragg, *Entomology*, p. 190 (1913).
[2] *The Natural History of Aquatic Insects*, pp. 113-122 (1903).
[3] *Zeits. f. Wiss. Zool.*, XVI, pp. 45-127, pls. iii-vii (1866).
[4] *The Mosquitoes of North and Central America and the West Indies*, I, p. 168, pl. viii (1912).

terior margin fringed with minute hairs. Further back is the *labrum* (fig. 2), which is an elongated structure and has a large number of setae arranged in a brush-like manner at its tip. The *mandibles* (fig. 3) are large, plate-like, with a narrow base, and have six large teeth on their anterior and upper margin and five small rounded serrations on the inner; besides there is near the upper margin on the outer side a small projection with six very long and broad bristles arising from its surface. The first pair of *maxillae* are reduced to small protuberances, each with two setae at the tip, and the *labium* is only a very small plate. The *eyes* are rather ovoid structures with a single large ocellus lying in a depression on the posterior margin of the eye. The *antennae* are large prehensile organs, consisting of a single joint; the line of attachment to the head is nearly straight; the outer margin of the antennae is concave; along the inner margin there is a deep notch close to the base, beyond which the line is straight; the tip is armed with four very long bristles. A few scattered setae are to be seen on the clypeus and just behind the eyes.

The *thorax* is a fairly massive structure; in full grown specimens it is thrice as broad as the head. On the dorsal surface of the thorax there are three groups of setae on each side; the first or the prothoracic group has two plumed setae, the second a simple and three plumed and the third only three plumed ones. The *air-sacs* are more or less kidney-shaped with the pigment arranged in small triangular or squarish areas; they are rather small as compared with those of the common European and American forms, being about one-sixth of the total thoracic length.

The *abdomen* consists of nine segments. The first six segments increase regularly in length and breadth, and the seventh and eighth gradually taper to the ninth segment. Each of the segments I—VIII bears a single plumed seta on each side dorsally and two plumed setae ventrally. The *air-sacs* on the seventh segment are, like those of the thorax, of a comparatively small size. The ninth segment has, close to its base, a papilla in the mid-dorsal line with two setae arising from it; posterior to it are two more papillae but without any setae; ventrally there is the large fin formed of nineteen long fringed bristles of the same type as described by Miall, *op. cit.* At the tip of the abdomen (fig. 4) there are four small triangular gills close to the anus. Above the gills are four very long feathered bristles arising in groups of two; below the gills is a large area something like the abdominal feet of *Chironomus*, and covered like these with two kinds of hooks (fig. 5), which are arranged, the larger and slightly curved ones in the centre and the smaller and more curved ones at the edges.

Pupa of *Chaoborus manilensis.*

A point in which the habits of these pupae differed from those of Palaearctic species was that they did not rise to the surface but remained floating in a vertical position close to the bottom; the large baloon-shaped breathing trumpets keeping them in this attitude. The very minute openings of the breathing trumpets, to be described later, seem to be due to the peculiar habitat in which they live, as finely powdered mud would choke up open trumpets, there being no large setae to guard

the openings as there are in other Culicidae ; and the gradual closing of the openings of the trumpets seems to have been evolved as a direct response to the surroundings in which these pupae are found. In captivity the adults were hatched only late at night and no observations were therefore made on the manner in which they rose to the surface. The pupa (fig. 6) is easily distinguished by the very long abdomen, and the comparatively small cephalo-thoracic mass, the peculiar breathing trumpets and the well-developed tail-fins.

The pupa is 6·9 mm. long, and the size of the cephalo-thoracic mass is 2·1 mm. by 1·7 mm.

In the cephalo-thoracic mass of the advanced pupae the large compound eye of each side with the single ocellus behind it and the antennae can be distinguished. The legs, the wing and the halter of each side can also be seen in their envelopes. Near the upper edge, arising from the dorso-lateral margins, a single seta is present on each of the pro-, meso- and metathoracic regions. The nymphal *breathing trumpets* are large swollen structures appearing baloon-shaped in the living pupae. They are broadest in the middle gradually narrowing to the point of attachment. The wall of the trumpet is formed of small quadrilateral areas. The outer openings are very minute slits on the upper margin.

In the abdominal portion, the segments regularly increase in length from the thorax onwards, except for the last one, which is very small. Dorsally each segment bears two setae one on each side, and there is a similar arrangement ventrally. From the last segment two triangular flaps hang out below the tail-fins. The tail-fins (fig. 7) are large, broad structures with a very thick inner margin owing to a tracheal tube running along the edge ; this edge is setose ; the outer edge is thinner and has no setae ; in the substance of the tail-fins of each side four other thickenings due to tracheal tubes can be distinguished.

LARVA OF *DIXA MONTANA*.

The larvae were collected in mountain streams at Kasauli in the Western Himalayas.

Full-grown larvae (fig. 8) measure about 9 mm. in length, smaller ones from 3—6 mm. are also present in the collection. The general colour of the preserved specimens is brownish-black alternating with paler areas on the dorsal surface, while the ventral surface is light yellow. The head and the tail-fins are dark brown.

The *head* is a small but massive structure formed of thick chitin. The post-antennal portion is quadrilateral, the anterior pre-antennal, which is much darker in colour, being triangular with the apex rounded off. The *eyes* are rather small, ovoidal, situated ventro-laterally behind the point of insertion of the antennae. The *antennae* (fig. 9) are slightly curved single-jointed structures about two-thirds of the length of the head, with the shaft and tip covered with closely-set minute spines.

Mouth-parts.—The pre-antennal portion of the head ends in the large *labrum* which, with its very well developed pair of feeding brushes, overhangs the mouth-opening. The *mandibles* (fig. 10) are large and elaborate in structure ; from the outer angle of the upper margin arises

a stout curved bristle hanging freely forwards. Internally the apex of the margin, which in the natural position faces that of the mandible of the other side, bears a large fringe of setae arranged on a crescentic ridge a little behind the edge; these setae together with the feeding brushes of the labrum are constantly in motion and sweep the food particles into the buccal cavity. A little above the middle there are two large teeth while the lower half is finely serrated. The first pair of *maxillae* (fig. 11) are quadrangular in outline with a well developed palp inserted near the base on the outer side; the palp like the antennae is spinose and of the same shape, though a little smaller. The inner margin of the plate of the maxillae is beset with long hairs, those at the apex being specially well developed and curved. The *second pair of maxillae* are united to form a triangular *labium*, which forms the floor of the buccal cavity.

The three segments constituting the *thorax* are quite distinct. Seen from above the segments are rectangular in outline. The middle segment is the largest of the three. The first segment has five simple setae on each side, arising near the anterior edge, and a single one behind this group. The second bears laterally two setae on each side; the third has no setae.

The eight segments of the *abdomen* are quite distinct. The first and second segments are peculiar in having two small feet, one on each side; these feet bear two types of hooks, the arrangement of which is the same as those described in *Chaoborus*, the larger ones in the centre and the smaller ones along the edges. The second to the seventh abdominal segments bear the so-called "shields" (Miall, *op. cit.*) on their dorsal surface. These are only the dorsal surfaces of the segments marked off as ovoid or nearly circular structures by the setae arranged along their margins. The setae are both simple and plumose, and are of use in supporting the surface-films of water, when in the looping movements the larva brings it above the surface. The absence of these shields in certain other species of *Dixa* larva suggests that they, together with the setae, may be efficient suckers of use to larvae living in rapid torrents in the hills, but I have no definite facts to support this assertion. On the ventral surface of segments five to seven there is, in addition to the shields mentioned above, a comb-shaped structure formed of minute brown spines attached in a transverse axis near the posterior margin of the segments. The structure of the eighth segment is very peculiar, having special bearings on the relationships of *Dixa*, and has, so far as I know, not been adequately described for any species. The segment itself is very large, the basal part being rectangular, with an elongated conical portion of a brownish colour projecting from the basal part. The tip of this conical portion bears three long setae on each side. On the two sides, and arising from the hind edge of the rectangular portion, are two triangular chitinous plates of a dark brown colour; these will be referred to again in the account of the respiratory or breathing portion. With each of these plates a rather elongated ovoid fin of a dark brown colour articulates; both the plates and the fins have a fringe of long setae along the inner and outer margins.

The spiracles, or the openings of the respiratory system of the larva are two in number, one on each side, situated in a slight depression on the dorsal surface of the eighth segment near the posterior margin of its rectangular portion. The spiracles are surrounded by six chitinous plates. When the larva is floating on the surface, the plates are spread out (fig. 8), and expose the spiracles to the air; when, however, the larva goes down from the surface, the plates, as in the larva of *Anopheles*, fold and with the fringes on their margins form a nearly closed cavity over the spiracles, enclosing air, which prevents water from entering the spiracles. The arrangement and shape of these plates is as follows: Anteriorly there is a large transverse plate bearing seven or eight groups of four to five setae each; from its position and the attachment of setae this thick plate appears capable of being turned over the spiracles, which from their situation would then be drawn underneath it. Arising behind the spiracle on each side is a chitinous plate of the shape of a tennis-racket; it is attached by the base of its handle; the broader portion, which stands free outside, is setose all along the margin. The chitinous plates further behind consist of a large crescentic plate, broad in the middle and drawn out along the two edges; these drawn-out portions are supported by the triangular plates with which the fins articulate.

This arrangement of the breathing mechanism of *Dixa* appears to be homologous with that of *Anopheles*, only it is on a lower grade of organization, all the essentials being the same. Both the mouth-parts and the breathing apparatus of *Anopheles* can be very easily derived from those of *Dixa;* and the resemblances do not seem to be of the nature of convergence, but rather to show a near relationship.

PUPA OF *DIXA MONTANA*.

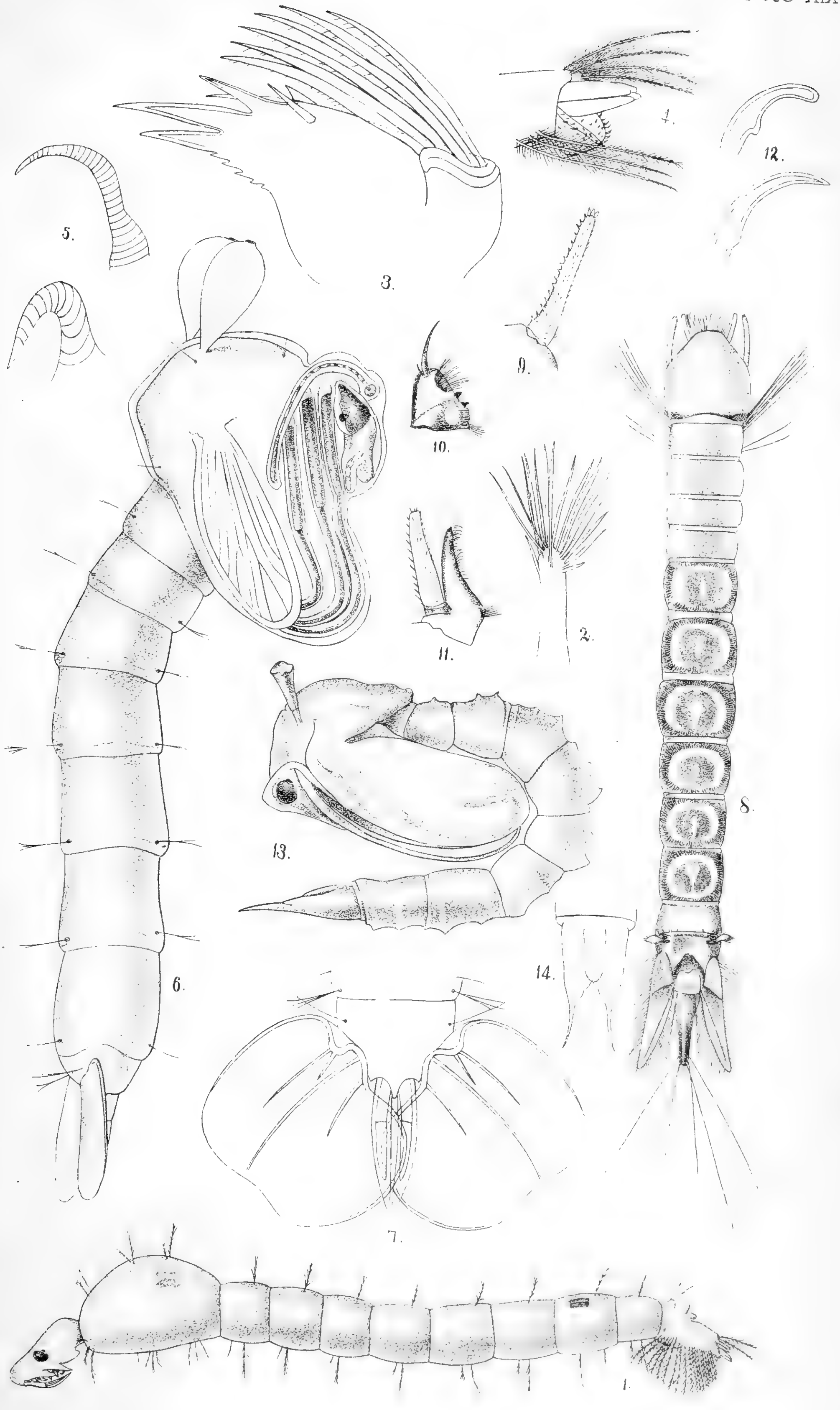
The pupa (fig. 13) is comma-like in appearance owing to the abdomen being bent under the large cephalo-thoracic mass. It is of a dark yellowish colour.

The cephalo-thorax measures 2 mm. by 9 mm. The divisional lines between the various abdominal segments are very well marked, and there are well developed ridges on the abdominal segments; there being no hairs or setae anywhere. The opening of the breathing trumpets is small, more or less squarish and lateral in position as usual. The tail-fins (fig. 14) are peculiar in being very much reduced triangular flaps, which are produced into a long regularly tapering spine a little smaller than the fins.

EXPLANATION OF PLATE XIX.

FIG. 1.—Lateral view of the larva of *Chaoborus manilensis*.
,, 2.—Lateral view of the larva of *C. manilensis*.
,, 3.—Mandible of the same.
,, 4.—Portion of the last abdominal segment of the larva more highly magnified.
,, 5.—The two types of hooks from the abdomen.
,, 6.—Pupa of *C. manilensis*, lateral view.
,, 7.—Tail-fins of the pupa as seen from above.
,, 8.—Larva of *Dixa montana*, dorsal view.
,, 9.—Antenna of the same.
,, 10.—Left mandible of the same as seen from above.
,, 11.—First maxilla of the left side as seen from above.
,, 12.—Two types of hooks from the abdominal feet.
,, 13.—Pupa of *D. montana*, lateral view.
,, 14.—Tail-fins of the pupa as seen in a dorsal view.

Plate XIX.



B.P. & D. Bagchi del.

D. Bagchi lith.

XX. FRESHWATER SHELLS FROM MESOPOTAMIA.

By N. Annandale, *D.Sc., F.A.S.B., Director, Zoological Survey of India.*

(With Plate XX.)

The shells discussed in this paper were found for the most part in what may be called a subfossil condition. Some of them may now be extinct in the districts in which they were collected, but this seems to be improbable in most cases, and some have certainly been deposited by recent inundations. The collection was made at two localities; in the neighbourhood of Nasariyeh on the Euphrates, near where it now joins the Tigris, and at Samara on the latter river. For most of the specimens I have to thank Lieutenant-Colonel W. H. Lane, whose valuable notes have been of great use in considering the environment in which the different species lived; for others I have to thank Bombardier R. Hodgart, who in civil life is a collector attached to the Zoological Survey of India, and while on active service has not neglected to obtain specimens for presentation to the Indian Museum.

The specimens from the neighbourhood of Nasariyeh are from three different deposits, probably of different age but in no case of great geological antiquity. Some are from a place annually inundated by the Euphrates, others from an almost superficial deposit now separated from the bank of the river but once probably the bed of a pool or backwater connected with it in the floods if not perpetually, while others again are from the bed of a shallow lake that has been filled from time to time with sand. There is some evidence that this last deposit was laid down in water that was or had recently been brackish. The specimens from Samara were found in the dry bed of an ancient tank and all the shells are white and opaque. Amongst the freshwater forms I found a number of money cowries (*Cypraea* (*Aricia*) *moneta*, L.), the presence of which is evidently fortuitous and due to man, and also shells of at least two species of Helicidae, which I shall not attempt to name.

The shells from the most recent deposit on the banks of the Euphrates at Nasariyeh belong to the following species:—

Gastropoda.	Pelecypoda.
Neritina jordani	*Corbicula fluminalis*
Melania tuberculata	*Corbicula cor*
Melanopsis nodosa	*Unio calliopsis*
Limnaea spp.	*Unio tigridis*
Planorbis convexiusculus	*Unio ciconius*
Bullinus contortus	*Gabillotia euphratica*

All these shells, except those of the Unionidae and Cyrenidae, are for the most part white and opaque. Some of those of Pulmonates,

however, retain a certain translucency; those of the *Melania* have often vestiges of epidermis, while those of *Neritina* retain their colour to some extent. Those of the *Melanopsis* are particularly white and chalky.

The shells from the swamp deposit in the same neighbourhood, separated from the Euphrates by a narrow stretch of flat land and the remains of an old embankment, belong to the following species:—

GASTROPODA.

Neritina jordani
Bithynia badiella
Melania tuberculata
Melanopsis nodosa
Limnaea tenera
Limnaea sp.
Bullinus contortus

PELECYPODA.

Unio sp.

Except the *Unio*, all the specimens of which are white, broken and crumbling, the shells are in much the same condition as those from recently inundated land.

The collection from the lacustrine deposit at Nasariyeh, to which Colonel Lane paid particular attention, includes specimens of the following:—

GASTROPODA.

Neritina jordani
Bithynia badiella
Bithinella palmyrae
Melania tuberculata
Melanopsis subtingitana, Nevill, Ms.
Melanopsis nodosa
Potamides fluviatilis
Limnaea peregriformis
Limnaea subpersica
Limnaea sp.
Planorbis convexiusculus
Bullinus contortus

PELECYPODA.

Unio sp.
Corbicula fluminalis
Corbicula cor
Corbula (*Erodona*) *mesopotamica*, sp. nov.

There is also a single shell of the barnacle *Balanus amphitrite*, and many tests of Ostracod Crustacea.

The collection of freshwater shells from Samara is a small one; only the following species are included:—

GASTROPODA.

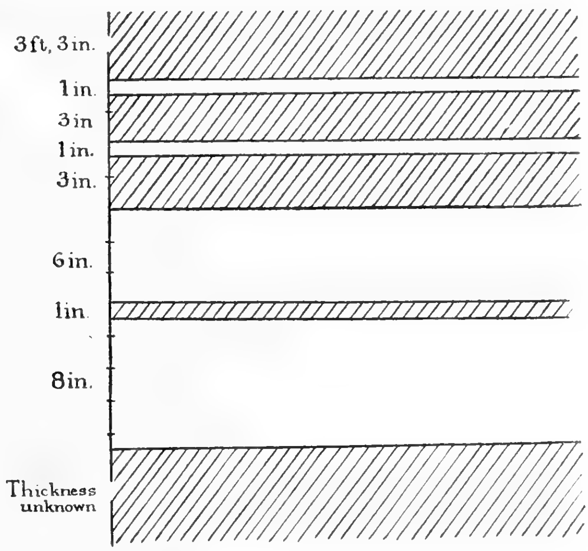
Melanopsis nodosa
Limnaea sp.
Bullinus contortus

PELECYPODA.

Corbicula fluminalis
Unio dignatus var. *semiramidis*
Unio mossulensis

The shells had all been dead for some time and were quite opaque.

The most interesting of these deposits, and also the most fully investigated, is that of the lake-bed near Nasariyeh. . Colonel Lane has sent me several diagrams to illustrate its position and structure. I reproduce (in a slightly modified form) one of his drawings, which is of a section of the deposit as seen in a trench. The sandy layers evidently represent the sudden and repeated filling in of the lake by sand-storms, the



layers of clay (shaded) the bottom at different periods. There has probably been some denudation of the surface. In the sandy layers the shells are well preserved, while in those of clay conditions were unfavourable for preservation and the only recognizable remains are those of thick and heavy shells such as *Unio* and the tests of Ostracods. Fragments of vegetable matter are abundant in the clay. There is some uncertainty as to which sandy layer many of the specimens are from, but there is sufficient evidence that some of the species came from all these layers; the *Potamides* and the *Corbula*, brackish-water forms, were certainly found in the upper as well as the lower ones; most of these shells are probably from the 6 inch layer. All the thinner shells from the deposit are dwarfed and many of those of *Limnaea* are distorted, but this is also the case with many specimens from recently inundated land in the same neighbourhood. Without examining fresh specimens it is impossible to say whether all of the latter are recent.

From a geographical point of view the most interesting feature of the collection is the additional evidence it affords of the close relationship between the aquatic fauna of lower Mesopotamia and that of the Jordan valley. The abundant occurrence of *Neritina jordani* in the former district is particularly significant in this connexion.

GASTROPODA.

Order *PECTINIBRANCHIATA*.

Family NERITIDAE.

Genus **Neritina**, Montfort.

Three species of this genus have been described from Mesopotamia and I have here to put on record the occurrence of a fourth hitherto known from Palestine. The four species are easily distinguished. They are *N. mesopotamica*, Mousson, *N. cinctella*, Martens, *N. euphratica*, Mousson and *N. jordani*, Sowerby. The first two are only known from upper Mesopotamia, but although *N. euphratica* is stated to be widely distributed through the whole country, none of the specimens I have examined can be assigned to it.

The four species may be distinguished as follows :—

I. Shell with an obtuse ridge on the body-whorl ... *N. cinctella.*
II. Shell with a broad, shallow constriction running round the main whorl, distinctly taller than broad, marked with dark and pale zig-zag lines ; the inner lip without denticulation or emargination ... ... *N. jordani.*
III. Shell without transverse constriction or ridge—
A. Shell slightly taller than wide, of a uniform blackish colour ; inner lip entire ... *N. mesopotamica.*
B. Shell wider than tall, marked with dark and pale zig-zag lines, with a slight emargination in the middle of the inner lip ... ... *N. euphratica.*

Neritina jordani, Sowerby.

1899. *Neritina jordani*, Kobelt in Rossmässler's *Icon. Land-u. Süssw. Moll.* (n. f.) VIII, p. 2, pl. ccxi, fig. 1319.
1899. *Neritina jordani* var. *turris*, *id.*, *ibid.*, p. 3, pl. ccxi, fig. 1320.

There are numerous shells of this species in collections from the bank of the Euphrates at Nasariyeh and from both lacustrine and paludine deposits in the same neighbourhood. They agree very closely, except in being rather smaller, with shells of the var. *turris* of Mousson collected by myself in the Lake of Tiberias. All are variegated, but there is considerable variation in the relative breadth of the dark and the pale zig-zag markings.

Family HYDROBIIDAE.

Bithynia badiella, Parreyss.

1874. *Bithynia badiella*, Mousson, *Journ. de Conch.* XXI, p. 45.

Shells are abundant in lacustrine and paludine deposits at Nasariyeh. They agree well with specimens from northern Palestine. The species is common in Syria, the Lake of Tiberias and Lower Mesopotamia.

Bithinella palmyrae, Dautzenberg.

1894. *Bithinella palmyrae*, Dautzenberg, *Rev. biol. Nord France* VI, p. 348, fig. 4.

Several shells, of which only one is complete, from the old lake-basin at Nasariyeh seem to agree with Dautzenberg's figure. The species is otherwise known only from Palmyra in the Syrian desert.

? Genus **Lithoglyphus,** Mühl.

A single broken shell from the same deposit perhaps belongs to this genus.

Family MELANIIDAE.

Melania tuberculata (Müller).

1918. *Melania tuberculata*, Annandale, *Rec. Ind. Mus.* XIV, pp. 114, 156, fig. 6, pl. xii, figs. 1, 2.

This common mollusc is well represented in all the deposits from which I have seen specimens. Most of the shells are of the typical form and of rather small size (not longer than 25 mm.). Mr. Hodgart has, however, sent some very large ones from the banks of the Euphrates at Nasariyeh, the largest of which must have been at least 45 mm. long by 16 broad when complete. Some of these large shells retain vestiges of their epidermis, but most are denuded and broken.

Melanopsis nodosa, Férussac.

1874. *Melanopsis nodosa*, Brot, "Die Melaniaceen," in Chemnitz's *Conch.-Cab.* (*ed.* Küster), p. 432, pl. xlvi, figs. 17-24.

This is apparently by far the commonest species of its genus in lower Mesopotamia. It is represented by numerous specimens from all the deposits at Nasariyeh and by a single much worn shell from Samara. All the shells I have examined have lost their epidermis and are white and chalky.

Melanopsis subtingitana, Nevill, Ms.

(Plate XX, figs. 1, 2.)

1884. *Melanopsis costata*, var., Nevill, *Hand-List Moll. Ind. Mus.* II, p. 262.

The shell is thick, of a very regular ovato-conical shape, narrow, sharply pointed at the apex, from which it increases gradually and evenly. The spire is conical, unbroken, with the suture little impressed and the whorls not at all swollen. Seven or seven and a half whorls persist in the two adult shells examined. The first three whorls are small and almost smooth; the others are decorated with broad and prominent, slightly sinuous longitudinal ridges, of which there are about fifteen. These ridges may become obsolete at the base of the body-whorl or may be divided into two longitudinal tubercles by a deep groove running round this whorl. The mouth of the shell is narrowly ellipsoidal and is produced backwards in the form of a narrow slit which is at first straight and then curves inwards and is not protected by an overhanging lip. The columella is almost straight and pointed at its extremity, which does not project or hardly projects beyond the lip; the callus is poorly developed.

Measurements of shells (in millimetres).

Specimen A is the type-specimen from Basra (?): specimen B is the adult shell from Nasariyeh.

	A.	B.
Length of shell	15	14
Breadth of shell	7·4	7·5
Length of aperture (including slit)	6·5	8·3
Breadth of aperture	3·5	3·2

Type-specimen.—No. 11390/2M, *Zoological Survey of India* (*Ind. Mus.*).

Localities.—Nevill gave the Ms. name here adopted to three shells labelled "Basrah, Biluchistan" from the collection of the late Dr. W. T. Blanford. The "Biluchistan" was probably a mistake. Two of these shells are very young and one of them appears to be merely a young shell of *M. nodosa.* The adult specimen I have made the type of the species. In Colonel Lane's collection from the old lake-bed at Nasariyeh I found two other shells, only one of them adult. They differ from Dr. Blanford's adult specimen in having the longitudinal ridges undivided and obsolete at the base on the body-whorl, but, considering the variability habitual in the genus, must belong to the same species. All four specimens were probably subfossil.

The species is closely related to *M. tingitana,* Morelet, which is probably confined to the western parts of the Mediterranean basin. It differs in its more regular form, narrower body-whorl, more conical spire and narrower aperture. It differs still more considerably in shape and proportions from any form of *M. costata,* of which I have examined a very large series of shells from Palestine, Spain, etc. From *M. saulcyi,* Bourguignat, it differs in sculpture as well as in the shape of the body-whorl.

Family CERITHIIDAE.

Potamides fluviatilis (Pott. & Mich.).

1838. *Cerithuom fluviatilis,* Potiez et Michaud, *Gall. Moll.*, p. 363, pl. xxxi, figs. 19, 20.

1916. *Potamides* (*Tympanotonos*) *fluviatilis,* Annandale and Kemp, *Mem. Ind. Mus.* V, p. 344.

Several worn and broken shells of this common estuarine species, the range of which extends from the Persian Gulf to the seas of China, Japan and Australia, are present in the collection from the sandy beds in the lake deposit at Nasariyeh. So far as I am aware, *P. fluviatilis,* though often abundant in water of low salinity, never lives in pure fresh water. The specimens, therefore, must represent, with those of *Corbula* and *Balanus,* a brackish-water element in this deposit.

Order *PULMONATA.*

Family LIMNAEIDAE.

Genus **Limnaea,** Lamarck.

The material at my disposal does not make it possible to deal in at all a satisfactory manner with the species or forms of this genus that

occur in lower Mesopotamia. A large proportion of the shells I have examined are immature or broken; all are very small and many seem to be distorted or abnormal. Some species of the genus are extraordinarily plastic and an enormous number of forms have received varietal or specific names. Indeed, it is doubtful whether a final diagnosis is possible in many cases without an examination of the radula and genital system. I have not attempted, therefore, to name the majority of specimens in the collection. They include representatives of curious races or varieties that may belong to such species as *L. lagotis* and *L. ovata* but, except in a few instances, I have not been able to identify them with described forms. All are certainly different from any of the forms from central Asia and from Baluchistan, Persia or Palestine represented by specimens in the collection of the Zoological Survey of India. In three cases I have been able to select series of shells that agree fairly well with published figures of supposed species. To these I give the appropriate names, but in so doing I wish it to be understood that I do not intend to express an opinion as to the specific validity of the forms.

Limnaea tenera (Parreyss), Küster.

(Plate XX, fig. 3.)

1862. *Limnaeus tener*, Küster, "Die Gattungen Limnaeus," etc., in Chemnitz's *Conch.-Cab.* (*ed.* Küster), p. 54, pl. xii, figs. 1, 2.
1865. *Limnaeus tener*, Tristram, *Proc. Zool. Soc. London*, p. 540.
1874. *Limnaea Euphratica*, Mousson, *Journ. de Conch.* XXI, p. 40.
1894. *Limnaea tenera*, Dautzenberg, *Rev. biol. Nord France* VI, p. 335.

This may be no more than an Asiatic race of *L. ovata*, which in its turn is probably no more than a phase of *L. peregra*. It was described from Persia and according to Dautzenberg is common in swamps and lakes in Syria. I have selected a series of shells from the specimens collected by Colonel Lane in a swamp-deposit at Nasariyeh. The larger specimens, though considerably smaller than Küster's figures, agree with them otherwise in every respect except that the mouth is slightly narrower.

Limnaea peregriformis, Locard.

(Plate XX, fig. 4.)

1883. *Limnaea peregriformis*, Locard, *Arch. Mus. d'Hist. Nat. Lyon* III, p. 286, pl. xxiii, figs. 41-43.

Several specimens from the lake-deposit at Nasariyeh agree fairly closely with Locard's figures, except that they are much smaller (not longer than 10·5 mm.) and that the body-whorl is sometimes not quite so elongate. I am not at all sure that the form is specifically distinct from the same author's *L. lagotopsis* and *L. reneana*, and Kobelt[1] is inclined to regard the former as no more than an individual aberration of *L. lagotis* and the latter as a young form of Locard's *L. axiaca*, which Westerlund calls a variety of *L. stagnalis*. According to Kobelt, however,

[1] Kobelt in Rossmässler's *Icon. Land-u. Süssw.-Moll.* (new edition) XVIII, pp. 2, 4, 5.

Westerlund calls *L. peregriformis* merely " *L. peregra* var. " *L. peregriformis*, whatever its precise status may be, has hitherto been recorded only from the Lake of Homs in Asia Minor.

Limnaea subpersica, Locard.

(Plate XX, fig. 5.)

1883. *Limnaea subpersica*, Locard, *op. cit.*, p. 285, pl. xxiii, figs. 38-40.

Some still smaller shells (greatest length 9 mm.) from the same deposit agree fairly well with Locard's figure, but show considerable variation in the form of the aperture. Westerlund (*fide* Kobelt, *op. cit.*, p. 7) regards the form as a variety of *L. lagotis*. It was found with *L. peregriformis* in the Lake of Homs.

Family PLANORBIDAE.

1906. Planorbidae, Pelseneer, " Mollusca " in Lankester's *Treatise on Zoology*, Vol. V, p. 185.

Genus **Planorbis,** Guttard.

The only species of this genus represented in the collection belongs to the section or subgenus *Gyraulus*, Agassiz.

Planorbis convexiusculus, Hutton.

1876. *Planorbis convexiusculus*, Hanley and Theobald, *Conch. Ind.*, pl. xcix, figs. 8, 9, 10.

1918. *Planorbis saigonensis* (?), Annandale, *Rec. Ind. Mus.* XIV, p. 112, pl. xi, fig. 1.

I have been in some doubt whether this form was more than a variety of *P. saigonensis*, Crosse & Fischer (=*P. compressus*, Hutton), but, having recently had an opportunity of examining good series of fresh specimens of both, I am now convinced that they are specifically distinct. *P. saigonensis* is a more constant species than *P. convexiusculus*, which exhibits considerable individual variability in the form of the shell. In most individuals of the latter species there is no peripheral keel or angulation, but it is not uncommon for a distinct angulation to be present. *P. saigonensis* has a larger, flatter, coarser and more irregularly sculptured shell, which is distinctly carinate. There is also a difference in the shape of the aperture. I have recently seen a number of specimens of *P. saigonensis* from Lahore which have traces of the bacterial velum so noticeable in *P. velifer*[1] ; some also possess spiral rows of epidermal cilia as in the var. *ciliata* of that species, from which both *P. convexiusculus* and *P. saigonensis* differ considerably in the shape of the mouth of the shell.

Shells of *P. convexiusculus* very like those from deposits in the Shan States are abundant in the samples from all the deposits at Nasariyeh and Samara. The species was described from Afghanistan and is common in northern India.

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[1] Annandale, *Rec. Ind. Mus.* XIV, p. 112, pl. xi, figs. 7-11 (1918).

Genus **Bullinus**, Adanson.

1757. *Bulinus*, Adanson, *Voy. Sénégal, Coquillages*, p. 5, pl. i, figs.
1815. *Bullinus*, Oken, *Lehrbuch Naturgesch.* III, p. 303 (*fide* Hedley).
1830. *Isidora*, Ehrenberg, *Symb. Phys.* II (unpaged).
1862. *Isidora* (in part), Küster, "Die Gatt. Limnaeus," etc., in Chemnitz's *Conch.-Cab.* (*ed.* Küster), p. 69.
1886. *Physa* (in part), Clessin, "Limnaeiden," in Chemnitz's *Conch.-Cab.* (*ed.* Küster and Dunker), p. 236.
1917. *Bullinus*, Hedley, *Rec. Austr. Mus.* XII, p. 3.

As this genus has now assumed a certain practical sanitary importance it may be well to discuss its synonomy and systematic position. It was originally described, from a West African form, by Adanson in 1757. He spelt the name with one "1," but as he derived it from "bulle" or *bulla* was evidently in error in so doing.[1] Apart, therefore, from any question of date, or from the fact that Adanson did not designate the species, Oken in 1815 was justified in changing the name to *Bullinus*. Oken's work is inaccessible to me, but I gather from recent writers that he merely adopted Adanson's description without seeing his species. This description is clear and adequate; the figures that accompany it, though a little crude, illustrate the form of the shell and the external anatomy of the animal with sufficient accuracy. They prove that in the species known to him, which was described by Bourguignat in 1856 as *Physa senegalensis*, the mantle did not extend over the shell and that the tentacles were filiform. These are characters which separate the living *Bullinus* from the living *Physa* at a glance.

In 1830 Ehrenberg erected for certain Egyptian and Syrian forms a new genus, which he called *Isidora* or the "Gift of Isis." He appears to have been ignorant of Adanson and Oken's genus and his description, which is fairly full both in reference to the shell and to the external soft parts, coincides closely with Adanson's. Moreover, the first two of the three species[2] he assigned to *Isidora* (*I. hemprichii*, *I. brocchii* and *I. forskalii*) are probably no more than varieties or phases of *Bullinus contortus*, which closely resembles *B. senegalensis* except in the poor development of the columellar callus. *Isidora*, therefore, seems to me to be an absolute synonym of *Bullinus*.[3] Germain,[4] however, treats it as a subgenus of that genus in his recent list of the molluscs of Syria and Palestine.

Pelseneer (*op. cit.*, 1906) places *Bullinus* with *Planorbis* in the family Planorbidae, which he defines thus: "Visceral mass and shell sinistrally coiled; inferior pallial lobe very prominent and transformed into a branchia; tentacles tapering." *Planorbis* he distinguishes thus: "shell discoid; branchia not folded": *Bullinus* thus, "shell ovoid with prominent spire; branchia folded." There is never any difficulty in distinguishing the flattened discoid adult shells of *Planorbis* from those

[1] He says, "Je donne le nom de Bulin a un petit coquillage d' eau douce. . . . . Cette denomination m'a paru lui convenir, parceque l'animal pendant sa vie nage presque continuellement a fleur d'eau, et qu'après sa mort sa coquille flotte comme une petite bulle d'air transparente."

[2] The third species (*i.e.*, the third to be described) *I. forskalii*, is quite distinct.

[3] Hedley (*op. cit.*, 1917) revives the name *Isidora* for certain Australian species in supersession of *Isidorella*, Tate; but in view of what is said above this cannot stand.

[4] Germain, *Bull. Mus. Hist. Nat.* (*Paris*) 1912, p. 450.

of *Bullinus*, but very young shells[1] are in some species almost indistinguishable.

Bullinus contortus (Mich.).

(Plate XX, figs. 6—11.)

1874. *Isidora contorta*, Jickeli, *Nov. Act. Leop-Carol. Ak. Natur.* XXXVII (1), p. 203, pl. iii, fig. 4, pl. vii, fig. 14.
1874. *Physa* (*Isidora*) *Brochii*, var. *approximans*, Mousson, *Journ. de Conch.* XXI, p. 42.
1886. *Physa contorta*, Clessin, *op. cit.*, p. 314, pl. i, figs. 9-11.
1886. *Physa natalensis*, *id. ibid.*, p. 8, pl. i, figs. 12-14.
1916. *Bullinus contortus*, Leiper, *Journ. R. A. M. C.* XXVII, p. 117, fig. 66.

Jickeli has discussed the synonomy and Leiper proved the sanitary importance of this species, which, with two closely allied forms, is the intermediate host of the human parasite, *Bilharzia haematobium*. The shell is extremely variable (see figs. 6—11, pl. XX) and it is possible that further study will extend the synonomy.

Specimens were obtained both in the swamp-deposit at Nasariyeh and at the edge of the Euphrates at the same place; also at Samara. The shells are small, rather thick, and extremely variable as regards both the form of the spire and the shape of the body-whorl. There are shells in the Indian Museum from Portugal, Corsica, Algeria, Egypt, Abyssinia, Natal and Palestine. The species is also known from tropical W. Africa, from the upper waters of the Euphrates, and from Syria.

PELECYPODA.

Family CYRENIDAE.

Genus **Corbicula,** Megerle.

A considerable number of species of this genus have been described from Western Asia, but the synonomy of these is obscure. I have distinguished two forms, which seem to be specifically distinct; others I have left unnamed.

Corbicula fluminalis (Müller).

1913. *Corbicula fluminalis*, Germain, *Bull. Mus. Hist. Nat.* (*Paris*), p. 472.

This is perhaps the commonest species of the genus in Western Asia. It has a wide range in Asia and Africa. Specimens, both recent and subfossil, from Nasariyeh seem to be typical.

Corbicula cor, Lk.

1914. *Corbicula cor*, Preston, *Journ. As. Soc. Bengal* (n. s.) IX, p. 474.

Specimens from Nasariyeh seem to be intermediate between this form and *C. crassula*, Mousson, which is probably, as Preston points out, a variety of it. They differ very little from shells from the Lake of Tiberias identified by the latter conchologist as *C. crassula*. The species, if the two be united, is common in Syria and there are specimens from Persia

[1] See Annandale, *Rec. Ind. Mus.* XIV, pl. xi, fig. 1 (1918)

in the collection of the Indian Museum. These are perhaps more like the typical *cor.* Germain (*loc. cit.*) treats *C. crassula* as a variety of *C. fluminalis.*

Family UNIONIDAE.

The Western Asiatic species of this family are described and figured piecemeal by Kobelt in the new edition of Rossmässler's "Iconographie," on which I have relied mainly in the following identifications. Volumes XVIII and XIX (1912-1913) contain most of the descriptions. There seems to be much confusion among the named shells from Mesopotamia in the Indian Museum.

Unio calliopsis (Bourg.), Kobelt.

1913. *Unio calliopsis*, Kobelt in Rossmässler's *Icon. Land-u. Süssw. Moll.* (n. f.) XIX, p. 15, pl. dxix, fig. 2703.

There are a number of fresh shells in Mr. Hodgart's collection from the banks of the Euphrates at Nasariyeh. Most of them are rather smaller than Kobelt's figure, but a single worn valve which has the characteristic hinge is larger: 62 mm. × 31 mm. The shell is thinner than the other Unionid shells in the collection and its epidermis is paler than that of other fresh specimens.

The species was described from Baghdad.

Unio tigridis, Bourguignat.

1912. *Unio tigridis*, Kobelt, *op. cit.*, XVIII, p. 62, pl. dx, figs. 2683, 2684.

Fresh shells from the same collection as the last species show considerable variation in outline and have the epidermis darker than it is shown in Kobelt's figures.

The species occurs in both the Tigris and the Euphrates.

Unio dignatus var. **semiramidis,** Kobelt.

1913. *Unio dignatus semiramidis*, Kobelt, *op. cit.*, XIX, p. 11, pl. dviii, fig. 2698.

Dead shells from Samara agree with Kobelt's figures. The variety was described from "the Euphrates near Baghdad."

Unio ciconius (Bourg.), Kobelt.

1913. *Unio ciconius*, Kobelt, *tom. cit.*, p. 11, pl. dvii, fig. 2697.

Shells were found, with those of the last species, at Samara by Colonel Lane. The type-specimens were collected near Mossul.

Gabillotia euphratica (Bourguignat).

1886. *Margaritana euphratica*, Kobelt, *op. cit.*, II, p. 26, pl. xlv, fig. 266.

A single fresh valve from the Euphrates at Nasariyeh agrees well with Kobelt's figure. The species has been found in the Tigris as well as the Euphrates.

Family CORBULIDAE.

Genus **Corbula,** Brugière.

The majority of the species of this family are marine, but a few make their way up the larger rivers of South America and southern Asia into water that is nearly if not quite fresh. Their range, however, never extends much beyond the limits of tidal influence. The shells of these brackish water forms are small, fragile and colourless, with prominent single hinge-teeth. The Asiatic and American species are probably convergent, but it may be convenient to group all the characteristic estuarine forms under the subgeneric name *Erodona*, Daudin. Preston[1] has described several species from the delta of the Ganges.

Corbula (Erodona) mesopotamica, sp. nov.

(Plate XX, figs. 12, 13.)

Shell small, thin, inaequivalve, inaequilateral, about $1\frac{1}{2}$ times as long as high, rounded in front, subtruncate and produced behind, moderately swollen in the central region; umbones pointed, small, slightly prominent, not at all introverted, situated slightly nearer the anterior than the posterior extremity; dorsal margin from umbo to upper end of anterior margin slightly convex, not interrupted, from umbo to posterior margin straight, sloping, hardly at all concave; lower margin convex, evenly curved; surface of upper part of shell with fine irregular transverse concentric striae; striae coarser near lower margin; no sloping ridges on posterior region. The form of the hinge is shown in figs. 12*a*, 13*a*, plate XX.

Measurements of shells (in millimetres).

	Right valve.	Left valve.
Breadth	8·5	8
Height	5·5	5·4

Type specimen.—No. 11404/2M, *Zoological Survey of India (Ind. Mus.).*

Locality.—Nasariyeh, Mesopotamia; subfossil in sandy beds of lacustrine deposit near the Euphrates.

The fresh shell was probably translucent, but a thin brownish epidermis, of which traces possibly persist, may have been present. The species comes nearest among described forms to *C. pfefferi*, Preston, from the Gangetic delta, but the shell is larger, proportionately broader and more produced posteriorly; the umbo is also more acute.

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[1] *Ann. Mag. Nat. Hist.* (7) XIX, p. 215 (1907).

EXPLANATION OF PLATE XX.

FRESHWATER SHELLS FROM MESOPOTAMIA.

Melanopsis subtingitana, sp. nov.

FIG. 1.—Type-specimen (? subfossil), probably from Basra, ×2.
,, 2.—Subfossil shell from lacustrine deposit at Nasariyeh, ×2.

Limnaea tenera (Parreyss), Mousson.

,, 3.—A series of subfossil shells from paludine deposit at Nasariyeh, ×2.

Limnaea peregriformis, Locard.

,, 4.—Subfossil shell from lacustrine deposit at Nasariyeh, ×2.

Limnaea subpersica, Locard.

,, 5.—Subfossil shell from the same deposit, ×2.

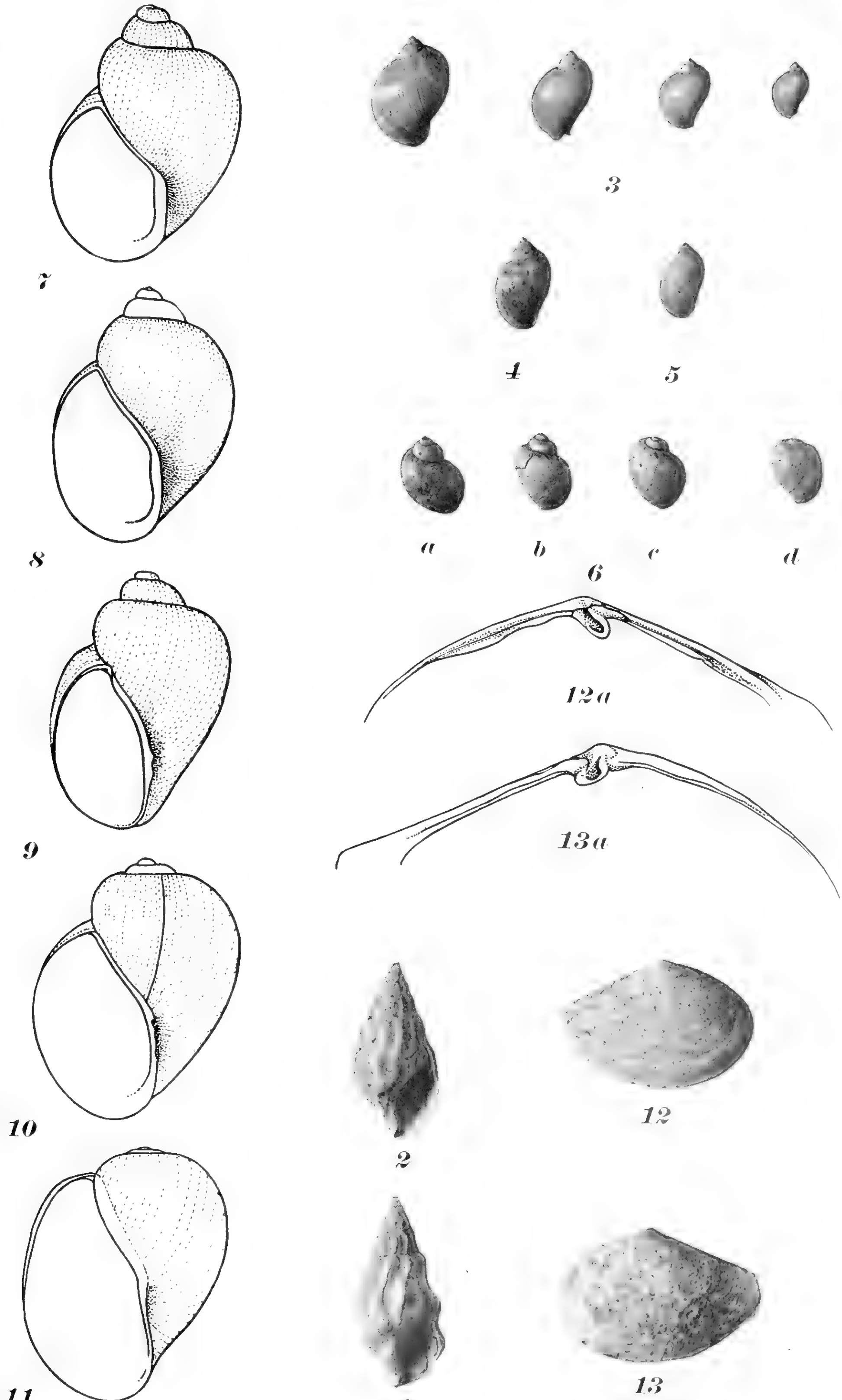
Bullinus contortus (Michaud).

,, 6.—A series of shells from Nasariyeh, ×2. *a*—*c*, shells from lacustrine deposit: *d*, shell from bank of Euphrates.

FIGS. 7-11.—Ventral view (further enlarged but not drawn to scale) of a series of shells from Nasariyeh and Samara. Figs. 7, 8, shells from bed of old tank at Samara; figs. 9, 10 (6*b*, 6*c*), from lacustrine deposit at Nasariyeh; fig. 11 (6*d*), from bank of Euphrates at same place.

Corbula (*Erodona*) *mesopotamica*, sp. nov.

FIG. 12.—Right valve of type-specimen (subfossil) from lacustrine deposit at Nasariyeh, ×4.
,, 12*a*.—Hinge of same, further enlarged.
,, 13.—Left valve of type-specimen, ×4.
,, 13*a*.—Hinge of same, further enlarged.



MESOPOTAMIAN SHELLS.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1918.

XXI. A NOMINAL LIST OF THE SCIURIDAE OF THE ORIENTAL REGION WITH A LIST OF SPECIMENS IN THE COLLECTION OF THE ZOOLOGICAL SURVEY OF INDIA.

By HERBERT C. ROBINSON, *C.M.Z.S.*,
and
CECIL BODEN KLOSS, *F.Z.S.*

We owe to the kindness of Dr. N. Annandale the opportunity of examining the whole collection of Oriental Sciuridae in the possession of the Zoological Survey of India, a collection which is of great interest to Mammalogists as containing the material on which the work of Blyth and Anderson was based. In the course of our work we have reviewed the whole recent literature of the group which, owing largely

ERRATA.

P. 193, line 7 *for* " Telbongo Peak " *read* " Tellizo Peak."
P. 193, line 9 *for* " Dunsiris " *read* " Dunsiri."
P. 193, line 16 *for* " Dirjung " *read* " Diyung."
P. 197, line 14 *for* " Dinapur " *read* " Dimapur."
P. 224, line 25 *for* " Harmuth Dikrang " *read* " Harmutti, Dikrang R., Dafla."
P. 239, line 20 *for* " Naga Hills " *read* " Dafla Hills."

... in the main followed Mr. R. C. Wroughton in his paper on " Oriental Flying Squirrels of the *Pteromys* group " [2] and like him have been compelled for the greater number of the forms to use a binomial nomenclature, though there is not the slightest doubt that the relationships of by far the larger proportion are merely subspecific and that, when a sufficient number of properly authenticated specimens are available, we shall be able to sort them out from the present unwieldy

[1] See also Hollister, N. H., List of the Mammals of the Philippine Islands, exclusive of the Cetacea. *Philippine Journ. Sci.* sec. D., vol. vii, no. 1, pp. 1-64 (1912).
[2] *Journ. Nat. Hist. Soc. Bombay*, XX, pp. 1012-23 (1911).

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The nomenclature used is as far as possible trinomial as best indicating natural relationships, but in many groups this has not been adopted, owing to paucity of material.

Family SCIURIDAE.

Subfamily *PETAURISTINAE.*

Genus **PETAURISTA,** Pallas, 1792.

In cataloguing the specimens of this genus in the Indian Museum we have in the main followed Mr. R. C. Wroughton in his paper on "Oriental Flying Squirrels of the *Pteromys* group"[2] and like him have been compelled for the greater number of the forms to use a binomial nomenclature, though there is not the slightest doubt that the relationships of by far the larger proportion are merely subspecific and that, when a sufficient number of properly authenticated specimens are available, we shall be able to sort them out from the present unwieldy

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[2] *Journ. Nat. Hist. Soc. Bombay*, XX, pp. 1012-23 (1911).

mass of names into a comparatively few groups. At present the only division that has been sufficiently studied is that represented in the Malay Peninsula and the Indo-Malayan Islands, which has been reduced to order by Mr. Oldfield Thomas.[1]

Petaurista petaurista.

a. **petaurista petaurista** (Pall.).

Zool. Misc. p. 54 (1766).

Typical locality.—West Java.
Type.—Not in existence.

b. **petaurista nigricaudatus,** Robinson and Kloss.

Journ. Fed. Malay States Mus., VII, p. 224 (1918).

Typical locality.—Idjen Massif, near Banjoewangi, East Java.
Type.—In Federated Malay States Museum.

♂ Sodong Jerok, Idjen Massif, near Banjoewangi, East Java, 3,900 ft., 30th March 1916. Mus. Coll. [C.]; skin and skull; Federated Malay States Museum [P.].

c. **petaurista melanotus** (Gray).

Charlesworth's *Mag. Nat. Hist.*, I, p. 584 (1837).

Typical locality.—Nepal (error). Malay Peninsula substituted.
Type.—In British Museum.

9745-6. [Siam] (Dr. Finlayson) [C.]; skins and skulls; *ex* India Museum, London.

It is practically certain that these specimens were not procured in Siam proper, where the form that occurs will probably be *P. p. cicur*, R. and K., but from some portion of the Malay Peninsula. Many of Finlayson's specimens labelled " Siam " are certainly not from that country.

d. **petaurista cicur,** Robinson and Kloss.

Ann. Mag. Nat. Hist. (8), XIII, p. 223 (1914).

Typical locality.—Ban Kok Klap, Bandon, Siamese Malaya.
Type.—In Federated Malay States Museum.

♂ Ban Kok Klap, Bandon, Siamese Malaya, 2nd July, 1913; skin and skull, H. C. Robinson and E. Seimund [C.]; Federated Malay States Museum [P.]. A paratype of the subspecies.

e. **petaurista rajah,** Thos.

Ann. Mag. Nat. Hist. (8), I, p. 251 (1908).

Typical locality.—Mount Dulit, Baram, Borneo, 2,000 ft.
Type.—In British Museum.

[1] *Ann. Mag. Nat. Hist.* (8), I, pp. 249-252 (1908).

f. **petaurista nitidulus** (Thos.).

Nov. Zool. VII, p. 592 (1900).

Typical locality.—Bunguran, North Natuna Islands.
Type.—In British Museum.

g. **petaurista batuanus** (Miller).

Smithsonian Misc. Coll. XLV, p. 27 (1903).

Typical locality.—Tana Bala, Batu Islands, West Sumatra.
Type.—In United States National Museum.

h. **petaurista terutaus** (Lyon).

Proc. Biol. Soc. Washington, XX, p. 17 (1907).

Typical locality.—Terutau Island, Northern Straits of Malacca.
Type.—In United States National Museum.

i. **petaurista mimicus** (Miller).

Smithsonian Misc. Coll. LXI, No. 21, p. 27 (1913).

Typical locality.—Pulau Rupat, East Sumatra.
Type.—In United States National Museum.

j. **petaurista marchio** (Thos.).

Ann. Mag. Nat. Hist. (8), I, p. 251 (1908).

Typical locality.—Si Rambi, Sumatra.
Type.—In British Museum.

Petaurista yunnanensis (Anderson).

Ann. Mag. Nat. Hist. (4), XVI, p. 282 (1875); *id., Anat. Zool. Res.,* p. 282, pl. xxii.

Typical locality.—Momein, Yunnan.
Type.—In Indian Museum.

9486. Momein, Yunnan, June 1868 (Dr. J. Anderson) [C.]; skin only.
9725-7. Momein, Yunnan, June 1868 (Dr. J. Anderson) [C.]; skin only.

No. 9486 is marked as type of species and of figure, but I think it probable that No. 9725 is at any rate the specimen figured.

Petaurista taylori, Thos.

Journ. Nat. Hist. Soc. Bombay, XXIII, p. 205 (1914); Kloss, *Journ. Nat. Hist. Soc. Siam,* II, pp. 33-35 (1916).

9721. ♀ Mergui (Dr. J. Anderson) [C.]; skin and skull.
Tenasserim (Rev. J. Barbe) [C.]; skin and skull.

The second specimen which is listed as "*k*" under *Pteromys alborufus* by Sclater (Cat Mamm. Ind. Mus. II, p. 35; 1891) is so faded as to be difficult to recognize but is apparently this form. It is, however, much less speckled than the specimen from Mergui. It is specimen No. 292-C of Blyth's catalogue.

Petaurista annamensis, Thos.

a. **annamensis annamensis,** Thos.

Loc. cit. supra., p. 204.

Typical locality.—Bali, Nha-trang, South Annam.
Type.—In British Museum.

b. **annamensis barroni,** Kloss.

Journ. Nat. Hist. Soc. Siam, II, p. 33 (1916).

Typical locality.—Hup Bon, Sriracha, South-east Siam.
Type.—In private possession.

7949. ♀ Hue Tam Din, Nampat, Monthon Pitsanoluk, Central Siam; 26th March 1902 (H. B. G. Garrett) [C.]; skin only, tail missing.

Petaurista candidulus, Wroughton.

Journ. Nat. Hist. Soc. Bombay, XX, p. 1014 (1911).

Typical locality.—Kindat, Upper Chindwin, Burma.
Type.—In British Museum.

9717. Assam (F. Day); skin and skull.
9718. Naga Hills, Assam (H. H. Godwin-Austen) [C.]; skin and skull.
9719. Samagooting, Assam (J. Butler) [C.]; skin and skull.
8015. ♂ Zoological Gardens, Calcutta; skin and skull.
9722. [Arakan] (Zoological Gardens, Calcutta); skin only.
9723 imm. Skin and skull.
9724 imm. (A. S. B. 292D.). Cherrapunji, Assam (W. Laidlay); skin and skull.
9720. Pegu (Revd. J. Barbe) [C.]; skin and skull.

The first specimen from Assam is unusually dark and the last from Pegu, which is a very old and much deteriorated specimen dating from 1844, differs from the rest in being browner and less rufous above with little or no darkening of any part of the tuft of hairs behind the ears. It possibly represents a transitional form to *P. cineraceus* (Blyth), but on the existing material is not describable.

Petaurista lylei, Bonh.

a. **lylei lylei,** Bonh.

P. Z. S., 1900, p. 192.

Typical locality.—Doi Sritepe, Chiengmai, N. Siam.
Type.—In British Museum.

b. **lylei venningi,** Thos.

Journ. Nat. Hist. Soc. Bombay, XXIII, p. 26 (1914).

Typical locality.—Kalaw, Southern Shan States, Burma.
Type.—In British Museum.

Petaurista alborufus (Milne-Edw.).

Compt. Rend., LXX, p. 342 (1870).

Typical locality.—Moupin, Eastern Tibet.
Type.—In Mus. Hist. Nat., Paris.

Petaurista cineraceus (Blyth).

Journ. Asiat. Soc. Bengal, XXI, p. 865 (1847).

Typical locality.—Arakan.
Type.—In Indian Museum, Calcutta.

9485,—. Arakan (Sir A. Phayre) [C.]; skins and skull. Nos. 292A, B; A. S. B. The types of the species.
9715. juv. Arakan (Sir A. Phayre) [C.]; skin and skull. One of the types of the species.

Blyth described this form on two adults and a small young specimen from Arakan, which are listed above, and another adult in worn pelage and unusually rufescent with darker tail than ordinary, from Tenasserim, which is the second specimen of *Petaurista taylori* (*cf.*, *supra*). Specimen 292B. (A. S. B.), one of the types of the species, is that listed as spm. " j " of *Pteromys alborufus* (Sclater, *loc. cit.*). In this stuffed specimen the tail is whitish.

9714. ♂ Arakan (Museum Collector); skin and skull.
3805, 3808. Menagerie specimens (W. Rutledge) [P.]; skins and skulls.
9716. ♀ juv. (W. Rutledge) [P.]; skull only.
9764. (?) skin and skull.

The last specimen was identified in the previous catalogue as *Eupetaurus cinereus*, Thomas, to which species it has some slight superficial resemblance.

Petaurista magnificus (Hodgs.).

Journ. Asiat. Soc. Bengal, V, p. 231 (1836).

Typical locality.—Nepal.
Type.—Co-types in British Museum and in Indian Museum, Calcutta.

9728. Nepal (Hodgson) [C.]; India Museum, London [P.]; skin and skull.
9729-30. Sikkim (L. Mandelli) [C.]; skins and skulls.
9733. Zoological Gardens, Calcutta; skin and skull.
7551. Menagerie specimen; skin and skull.
7268. Menagerie specimen (W. Rutledge); skin and skull.
9732. Darjiling (W. Earle) [C.]; skull.

In this small series all gradations from a form with a clearly defined median stripe on the back to one with no stripe at all are present. In view of Hodgson's specimen above which has the upper surface ungrizzled I have used his name for the species rather than the later one *P. nobilis*, Gray, which has been adopted by Wroughton (*Journ. Nat. Hist. Soc. Bombay*, XX, p. 1020; 1911) who has transferred *P. magnificus* as a synonym to the larger grizzled form to which he has applied the name *P. albiventer*, Gray.

Petaurista albiventer, Gray.

Ill. Ind. Zool., II, pl. xviii (1834).

Typical locality.—" Nepal."
Type.—In British Museum.

9731 (A. S. B.). Cherrapunji, Assam (F. Skipwith) [C.]; skin only.

Petaurista fulvinus, Wroughton.

Journ. Nat. Hist. Soc. Bombay, XX, p. 1021 (1911).

Typical locality.—Simla, Western Himalayas.
Type.—In British Museum.

Petaurista inornatus (Is. Geoffr.).

In Jacquemont's *Voyage,* IV, Mamm., p. 62, Atlas, ii, pl. iv (1844).

Typical locality.—North India.
Type.—In Mus. Hist. Nat., Paris.

9734. Ladakh (J. Biddulph) [C]; skin and skull.
9735. Sonamarg, Kashmir, August 1878 (F. Stoliczka) [C]; skin and skull.
9736. Kashmir (Dr. J. E. T. Aitchison) [C]; skin and skull.
7408. Mussoorie (Miss K. Southon) [C]; skin and skull.
9737-8. Sikkim (L. Mandelli) [C]; skins and skulls.
7632. ♂ juv. Zoological Gardens, Calcutta; skin and skull.

Petaurista birrelli, Wroughton.

Journ. Nat. Hist. Soc. Bombay, XX, p. 1019 (1911).

Typical locality.—Murree, Hazara, Punjab.
Type.—In British Museum.

Petaurista melanopterus, Milne-Edw.

Ann. Sci. Nat. Zool., VIII, p. 375 (1867).

Typical locality.—Tcheli, China.
Type.—In Mus. Hist. Nat., Paris.

Petaurista caniceps (Gray).

Ann. Mag. Nat. Hist., X, p. 262 (1842).

Typical locality.—Sikkim.
Type.—In British Museum.

9740 (A. S. B.). Landour, North-Western Himalayas (1854) (L. E. Stewart) [C]; skin and skull.
9741-3. Sikkim (L. Mandelli) [C]; skins and skulls.
9744. Gumphar, near Darjiling, 2,000 ft. (J. Knight) [C]; skin and skull.
9739 imm. ? Sikkim; skin only.

Petaurista pectoralis (Swinh.).

P. Z. S., 1870, p. 654.

Typical locality.—Takow, South-West Formosa.
Type.—In British Museum.

Petaurista leucogenys (Temm.).

Mon. Mamm. Tab. Method., I, p. 27 (1827).

Typical locality.—Japan.
Type.—In Leyden Museum.

Petaurista elegans (Temm.).

Mueller and Schlegel, *Verhandl. Nat. Gesch.*, 1839-44, pp. 107, 112, pl. xvi, figs. 1-3.

Typical locality.—Island south of Nusa Kumbang, South Java.
Type.—In Leyden Museum.

Petaurista philippensis.

a. **philippensis philippensis** (Elliot).

Madras Journ. Lit. and Sc., p. 217 (1839).

Typical locality.—Near Madras.
Type.—? In British Museum.

9708-9. Travancore; skins and skulls.
9805 imm. Hulekal, Sirsi, Kanara, 1,500 ft., April 1912; G. C. Shortridge, Bombay Nat. Hist. Soc. Mammal Survey [P.]; skin and skull.

b. **philippensis oral** (Tick.).

Journ. Nat. Hist. Calcutta, II, p. 401, pl. xi (1842).

Typical locality.—Singhbhum district, Bengal.
Type.—?.

9711, 9712 (A. S. B.). No locality; skulls only.
Juv. Midnapur

The allocation of these skulls, without any provenance, to this form is of course quite hypothetical. They are considerably smaller than those of *P. p. philippensis* from Travancore. A third skull also marked as *oral* is that of a species of *Ratufa*, probably *R. gigantea*.

9043. Zoological Gardens, Calcutta; skin and skull.

This is only a one-third grown specimen and is marked as coming from Assam; this however is probably only the locality of the species, *Hy. alboniger*, with which it has been identified.

c. **philippensis cinderella,** Wroughton.

Journ. Nat. Hist. Soc. Bombay, XX, p. 1018 (1911).

Typical locality.—Surat District, Bombay.
Type.—In British Museum.

7311. Rourkel district, Nagpur (B. D. Whiffen) [P.]; skin only.

d. **philippensis lanka,** Wroughton.

Op. cit. supra, p. 1017 (1911).

Typical locality.—Ceylon.
Type.—In British Museum.

9710. Ceylon (Colombo Museum) [P]; skin and skull.

Petaurista punctatus.

a. **punctatus punctatus** (Gray).

Ann. Mag. Nat. Hist., XVIII, p. 211 (1846).

Typical locality.—Malacca.
Type.—In British Museum.
Also collected by Fea on the Karin Hills.

b. **punctatus marica,** Thos.

Ann. Mag. Nat. Hist. (8), IX, p. 627 (1912).

Typical locality.—Yunnan (probably near Mong-tze).
Type.—In British Museum.

c. **punctatus sybilla,** Thos.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 424 (1916).

Typical locality.—Chin Hills (near Kindat, Upper Burma).
Type.—In British Museum.

Sp. incert.

9057. Yung Ping, Heien, Yunnan, 22nd February 1909 (J. Coggin Brown) [C]; skin and skull.

This specimen, which is far too young to describe, probably represents a new form allied to the *annamensis-alborufus* section, if indeed it does not belong to the latter form, of which we have seen no authentic specimens.

Genus **EUPETAURUS,** Thomas, 1888.

Eupetaurus cineraceus, Thos.

Journ. Asiat. Soc. Bengal, LVII, p. 258, pls. xxii, xxiii (1888).

Typical locality.—Gilgit Valley.
Type.—In British Museum. Co-type in Indian Museum.

9492. Gilgit Valley, 5,000 ft. (G. M. Giles) [C.]; skin and skull. Co-type of the species.

Subfamily *PTEROMIINAE.*

Genus **IOMYS,** Thomas, 1908.

Iomys horsfieldi.

a. **horsfieldi horsfieldi** (Waterhouse).

P. Z. S., 1837, p. 87.

Typical locality.—Java (or Sumatra)
Type.—In British Museum.

b. **horsfieldi davisoni** (Thos.).

P. Z. S., 1886, p. 74, pl. vi.

Typical locality.—Malacca.
Type.—In British Museum.

c. **horsfieldi thomsoni** (Thos.).

Ann. Mag. Nat. Hist., (7), V, p. 275.

Typical locality.—Baram, Sarawak.
Type.—In British Museum.

d. **horsfieldi lepidus,** Lyon.

Proc. U. S. Nat. Mus., XL, p. 78 (1911).

Typical locality.—Kendawangan River, South-west Borneo.
Type.—In United States National Museum.

Genus **BELOMYS,** Thomas, 1908.

Belomys pearsoni (Gray).

Ann. Mag. Nat. Hist., X, p. 263 (1842).

Typical locality.—Darjiling, Sikkim.
Type.—In British Museum ?.

9786. Darjiling (W. Theobald); skull only.

Belomys villosus (Blyth).

Journ. Asiat. Soc. Bengal, XVI, p. 866 (1847).

Typical locality.—Upper Assam (Singpho country).
Type.—In Indian Museum, Calcutta.

9488. North Assam (F. Bonynge), co-type of *Sc. villosus*; skin only.
9489. North Assam (F. Bonynge), cotype of *Sc. villosus*; skin and skull.
? 9770. Naga Hills (H. H. Godwin-Austen); skin and skull.
? 9771. Cachar (Mus. Coll.); skin and skull.
? 9769. Assam (A. W. Chennell); skin and skull.

Belomys trichotis, Thos.

Ann. Mag. Nat. Hist., (8), I, p. 7 (1908).

Typical locality.—Machi, Manipur.
Type.—In British Museum.

? 9758. Momein (J. Anderson); skin and skull.
? 9772. Momein (J. Anderson); skull only.

Belomys kaleensis (Swinh.).

P. Z. S., 1862, p. 359.

Typical locality.—North Formosa.
Type.—In British Museum.

Of the above examples of the genus *Belomys* the skull of *pearsoni* (9786, Darjiling) agrees with the characters given by Thomas (*Ann.*

Mag. (8), I, p. 7) in having the palate breadth between the large premolars (*pm.*—) only equal to the length of $pm^4 + \frac{1}{2}\ m^1$.

The Assam example (9489, cotype of *villosus* : 9488 having no skull) has rather smaller teeth and possesses the characters given for *trichotis*, Thomas, of Manipur, in having the palate breadth equal to the length of $pm^4 + m^1$, as does that of the Cachar specimen (9771) which resembles it generally ; but the second Assam skull (9769), which also has about the same ratio of palate breadth to tooth row, is otherwise very different from all the rest in being larger with a much heavier, blunter rostrum ; considerably greater breadth in general and larger, markedly broader teeth ; it is however the oldest of the lot.

The Naga Hill skull (9770) more nearly resembles *pearsoni*.

The only Momein skull (9758) agrees with the majority in form, except that the bullae seem smaller, but it has the proportion of palate breadth to teeth as in *pearsoni* ; it has however teeth nearly as broad as No. 9769 of Assam, with the longest tooth row of all and pm^3 very large indeed—larger than in *pearsoni*.

The skins are in poor condition but do not seem separable on colour ; either, however, too many forms have been recognised, or not enough.

Genus **PTEROMYSCUS,** Thomas, 1908.

Pteromyscus pulverulentus.

a. **pulverulentus pulverulentus** (Gunther).

P. Z. S., 1873, p. 413, pl. xxxviii.

Typical locality.—Penang.
Type.—In British Museum.

b. **pulverulentus borneanus,** Thos.

Ann. Mag. Nat. Hist., (8), I, p. 17 (1908).

Typical locality.—Baram, Sarawak.
Type.—In British Museum.

Genus **PETAURILLUS,** Thomas, 1908.

Petaurillus hosei (Thos).

Ann. Mag. Nat. Hist., (7), V, p. 275 (1900).

Typical locality.—Baram, Sarawak.
Type.—In British Museum.

Petaurillus emiliae, Thos.

Ann. Mag. Nat. Hist., (8), I, p. 8 (1908).

Typical locality.—Baram, Sarawak.
Type.—In British Museum.

Petaurillus kinlochi, Robinson and Kloss.

Journ. Fed. Malay States Mus., IV, p. 171 (1911).

Typical locality.—Selangor, Malay Peninsula.
Type.—In Federated Malay States Museum.

Genus **HYLOPETES,** Thomas, 1908.

Hylopetes everetti (Thos).

Nov. Zool., II, p. 27 (1895).

Typical locality.—Bunguran Island, South China Sea.
Type.—In British Museum.

Hylopetes nigripes (Thos.).

Ann. Mag. Nat. Hist., (6), XII, p. 30 (1893).

Typical locality.—Palawan Island.
Type.—In British Museum ?

Hylopetes aurantiacus (Wagn.).

Munch. Gel. Anz., XII, p. 438 (1841).

Typical locality.—Island of Banka, East of Sumatra.
Type.—Presumably in Munich Museum.

Hylopetes belone (Thos.).

Ann. Mag. Nat. Hist., (8), II, p. 305 (1908).

Typical locality.—Terutau Island, Northern Straits of Malacca.
Type.—In British Museum.

Hylopetes amoenus (Miller).

Proc. U. S. Nat. Mus., XXXI, p. 264 (1907).

Typical locality.—Kundur Island, Rhio Archipelago, near Singapore.
Type.—In United States National Museum.

Hylopetes platyurus (Jent.).

Notes Leyden Museum, XII, pp. 145, 147, pl. vii, figs. 7, 8 (1890).

Typical locality.—Deli, North-east Sumatra.
Type.—In Leyden Museum.

Hylopetes phayrei.

a. **phayrei phayrei** (Blyth).

Journ. Asiat. Soc. Bengal, XXVIII, p. 278 (1859).

Typical locality.—Rangoon, Burma.
Type.—In Indian Museum, Calcutta.

9490. Rangoon, Burma; skin and skull. Cotype.
9491. Burma. Sir A. Phayre and Major Berdmore (cotype); skin only.
7232. Pegu Yomas. O. L. Fraser; skull only.
9767. Skin only.
9768. Skin and skull.

b. **phayrei probus** (Thomas).

Journ. Bombay Nat. Hist. Soc., XXIII, p. 27 (1914).

Typical locality.—Mount Popa, Burma.
Type.—In British Museum.

c. **phayrei laotum** (Thomas).

Journ. Bombay Nat. Hist. Soc., XXIII, p. 28 (1914).

Typical locality.—Laos Mountains.
Type.—In British Museum.

Hylopetes spadiceus (Blyth).

Journ. Asiat. Soc. Bengal, XVI, p. 867 (1847).

Typical locality.—Arakan.
Type.—In Indian Museum, Calcutta.

9765. Arakan. Sir A. Phayre, type of the species; skin and skull.
9766. Moulmein, Tenasserim. J. Davis; skin and skull.

Hylopetes alboniger (Hodgson).

Journ. Asiat. Soc. Bengal, V, p. 231 (1836).

Typical locality.—Nepal.
Type.—In British Museum.

8428. Nepal. R. A. Hodgert; skin and skull imm.
9755. Darjiling. Mrs. Oates; skin and skull imm.
9756. Garo Hills. H. L. Haughton; skin and skull imm.
9763. Shillong. T. la Touche; skin only.
9757. Cachar Hills; skin and skull.
9762. Naga Hills. A. W. Chennell; skin only.
9759. Momein. J. Anderson; skin only.
9760. W. Rutledge; skin and skull.
9761. Skin and skull.

The validity and generic position of the following three races are doubtful.

? **sagitta** (Linn.).

Syst. Nat., I, p. 88 (1766).

Typical locality.—Western (?) Java.
Type.—Disappeared.

? **lepidus** (Horsf.).

? [Synonym of *sagitta*, of Thos. and Wr., *P. Z. S.*, 1909, p. 387]; *Zool. Res. in Java*, 1824 (description and plate).

Typical locality.—Java.
Type.—Disappeared.

? **harrisoni** (Stone).

Proc. Acad. Nat. Sci. Philadelphia, XLII, p. 462 (1900).

Typical locality.—Borneo.
Type.—In Philadelphia Academy of Sciences.

Genus **ÆROMYS,** Robinson and Kloss, 1915.

Æromys tephromelas (Gunther).

P. Z. S., 1873, p. 413, pl. xxxvii.

Typical locality.—Penang.
Type.—In British Museum.

Æromys phaeomelas (Gunther).

P. Z. S., 1873, p. 413.

Typical locality.—Borneo.
Type.—In British Museum.

? **Æromys thomasi** (Hose).

Ann. Mag. Nat. Hist., (7), V, p. 214 (1900).

Typical locality.—Baram, Sarawak.
Type.—In British Museum.

Genus **PETINOMYS,** Thomas, 1908.

Petinomys lugens (Thos.).

Ann. Mus. Stor. Nat. Genova, XIV, p. 666 (1894).

Typical locality.—Island of Sipora, West Sumatra.
Type.—In Genoa Museum.

Petinomys maerens (Miller).

Smithsonian Misc. Coll., XLV, p. 26 (1903).

Typical locality.—North Pagi Island, West of Sumatra.
Type.—In United States National Museum.

Petinomys genibarbis.

a. **genibarbis genibarbis** (Horsf.).

Zool. Res. in Java, 1824 (description and plate).

Typical locality.—Eastern Java.
Type.—In British Museum.

b. **genibarbis malaccanus** (Thos.).

Ann. Mag. Nat. Hist., (8), II, p. 304 (1918).
Typical locality.—Malacca.
Type.—In British Museum.

c. **genibarbis borneonensis** (Thos.).

Loc. cit. supra, p. 304.
Typical locality.—Bakong River, East Sarawak, Borneo.
Type.—In British Museum.

Petinomys vordermanni (Jent.).

Notes Leyden Museum, 1890, p. 150, pl. vii, figs. 13 and 14.

Typical locality.—Island of Billiton, East Sumatra.
Type.—In Leyden Museum.

Petinomys setosus (Temm. and Schlegel).

Faun. Japon., 1847, Mamm., p. 49.

Typical locality.—Padang, Sumatra.
Type.—In Leyden Museum.

Petinomys hageni (Jent.).

Notes Leyden Museum, XI, p. 26 (1888).

Typical locality.—Deli, Sumatra.
Type.—In Leyden Museum.

Petinomys phipsoni, Thomas.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 422 (1916).

Typical locality.—Tenasserim town, Tenasserim.
Type.—In British Museum.

Petinomys fuscocapillus (Jerdon in Blyth).

Journ. Asiat. Soc. Bengal, XVI, p. 867 (1847).

Typical locality.—South India (Nilgiri Hills ?).
Type.—Apparently not in existence ?

Genus **EOGLAUCOMYS,** Howell, 1915.

Eoglaucomys fimbriatus (Gray).

Ann. Mag. Nat. Hist., I, p. 584 (1837).

Typical locality.—Western Himalayas.
Type.—In British Museum.

8990. Kashmir, 10,000 ft., J. Scully [C.]; skin and skull.
9747. Chitral, 5,000 ft., G. M. Giles [C.]; skin and skull juv.
9748. Nultar Valley, Gilgit (A. E. Ward) [C.]; skin only.
9749. Nultar Valley, Gilgit; skin and skull.
9750. Chaprot, Gilgit; skin and skull.
9751. Gilgit, 6,000 ft.; skin and skull.
9752. Ladak. J. Biddulph [C.]; skin and skull.
9753. Kashmir. J. Anderson [C.]; skin only.
9754. Simla. L. C. Stewart [C.]; skin only.

Not to be regarded as an Oriental species.

Subfamily *SCIURINAE.*

Genus **RATUFA**, Gray, 1867.

Ratufa macroura.

a. **macroura macroura** (Pennant).

Ind. Zool., I, pl. i (1769).

Typical locality.—Highlands of Ceylon.
Type.—Not in existence.

9472 (A. S. B.). Ceylon (Dr. Kelaart); skin only.

This specimen, though marked as the type of *Sc. teanantii* (*sic.*) Layard (Blyth, *Journ. Asiat. Soc., Bengal*, XVIII, p. 600; 1849) cannot I think so be regarded. The present specimen is that referred to by Blyth two years later [*op. cit.*, XX, p. 165 (1851)].

9283 (A. S. B.). Ceylon (Dr. Kelaart); skull only.

b. **macroura melanochroa,** Thos. and Wrought.

Journ. Nat. Hist. Soc. Bombay, XXIV, pp. 36, 90 (1915).

Typical locality.—Southern Ceylon (Kottawa).
Type.—In British Museum.

9278. Ceylon (Colombo Museum) [P.]; skin and skull.
9280. Ceylon (Zoological Gardens); skin only.

c. **macroura albipes** (Blyth).

Journ. Asiat. Soc. Bengal, XXVIII, p. 287 (1859).

Typical locality.—Unknown.
Type.—Once in the Medical College, Calcutta; probably now not in existence.

9281. Nilgiris, Southern India (R. Rolls) 1845; skin.
9279. ♂ Shevaroy Hills, Madras (W. Daly); skin and skull.

Thomas and Wroughton have apparently overlooked the existence of this form, which, however, is well characterised by Blyth. In view of the fact that the continental and insular races of squirrels are almost invariably distinct I have allowed the succeeding form to stand.

d. **macroura dandolena,** Thos. and Wrought.

Loc. cit. supra, pp. 36, 90.

Typical locality.—Lowland Ceylon, Wellawaya, Uva.
Type.—In British Museum.

9779, 9785. Ceylon (E. L. Layard); skins and skulls.
9282. Ceylon (Dr. R. Templeton); skin and skull.

The latter number is evidently the specimen described and figured by Blyth as *Sciurus macrourus* (*J. A. S. B.*, XVI, p. 869, pl. xxxvi, fig. 2, 1847).

It is, as stated in the description, a decidedly smaller animal. Greatest length of present skull 67 as against 70 mm. in 9283. In colour

it is rather dark, with grizzled sides and a black line from behind the ear down the cheeks.

Ratufa indica.

a. **indica indica** (Erxleben).

Syst. Regn. An., p. 420 (1777).

Typical locality.—Bombay Presidency.
Type.—Not in existence.

Deccan (Sykes). India Mus., London [P], skin and skull.
Probably a paratype of *Sciurus elphinstonii*, Sykes (*P. Z. S.*, 1831, p. 103).
9787. ♂ Samasgi, Kanara border, South-West Dharwar, 2,000 ft., March 1912; (G. C. Shortridge) [C.], Bombay Nat. Hist. Soc. Mammal Survey [P.]; skin and skull.
9788 ♂ Devikop, South Mahratta country, 2,000 ft., November 1911; (G. C. Shortridge) [C.]. Bombay Nat. Hist. Soc. Mammal Survey [P.]; skin and skull.

b. **indica superans,** Ryley.

Journ. Nat. Hist. Soc. Bombay, XXII, p. 436 (1813).]

Typical locality.—Wotekolli, South Coorg.
Type.—In British Museum.

9972. Wotekolli, 2,000 ft., South Coorg, January 1913 (G. C. Shortridge) [C.]. Bombay Nat. Hist. Soc. Mammal Survey [P.]. Paratype of the subspecies.

c. **indica bengalensis** (Blanf.).

Journ. Nat. Hist. Soc. Bombay, XI, p. 303, pl. B, fig. 2 (1897).

Typical locality.—Not precisely specified.
Type.—In British Museum.

9605, 9606. 2♂ Menagerie specimens (W. Rutledge); skins.
9612 (A. S. B.). Barrackpore Menagerie; skin and skull.
9602-3. (J. Anderson) [C.]; skins and skulls.
9604. (Lord Northbrook) [P.]; skin.
9587 (A. S. B.). No history; skull only.

d. **indica centralis,** Ryley.

Loc. cit. supra, p. 436.

Typical locality.—Hosengabad, Central Provinces.
Type.—In British Museum.

9789-90. ♂ ♀ Bori, Hosengabad, 1800 ft., Central Provinces; February 1912; (C. M. Crump) [C.]; Bombay Nat. Hist. Soc. Mammal Survey [P.]; skins and skulls.
Skins almost destroyed by pests. Topotypes.
9597. Malabar (Alston).
Like that of many specimens derived from this source this locality is probably incorrect.
9600-1 (A. S. B.). ♀ No history; skins and skulls.
9784. No history; skin and skull.
9607-9. 2♂ ♀ Menagerie specimens (Rutledge); skins.
9611, 9613 (A. S. B.). No history; skin and two skulls.
7954. ♂ No history; skin and skull.
9593. Cuttack, Orissa (Ball) [C.]; skin and skull.
9614-5. ♂ ♀ Tenmalai, South Arcot (W. P. Howell) [C.]; skins and skulls.

The material is somewhat indifferent and the allotment of skulls unaccompanied by skins to this subspecies is not a matter of absolute

certainty. The specimen from Orissa has distinctly black shoulders and is not therefore true *R. i. centralis.* Those from Arcot have the red colour paler, the black rump and shoulders more sharply differentiated from the red portions of the pelage.

e. **indica maxima** (Schreb.).

Saugth., IV, p. 784, pl. ccxxii, B (1784).

Typical locality.—Malabar.
Type.—In Paris Museum.

9594, 9598. Travancore; skins.
9616-9617. Travancore (Travancore Museum) [P.]; skins and skulls.
9595. South Malabar. Revd. J. Baker [C.]; skin and skull.
9595 (A. S. B. 307A). South Malabar.
9596 (A. S. B. 307B). South Malabar; skin and skull.
7102. ♀ Calathorpulay, Travancore (Mus. Coll.); skin and skull.
9610. South Malabar; skull only.

e. **indica dealbata** (Blanf.).

Journ. Nat. Hist. Soc. Bombay, XI, p. 299 pl. A, fig. 1 (1897).

Typical locality.—Surat Dangs.
Type.—In British Museum.

Ratufa bicolor.

a. **bicolor bicolor** (Sparrm.).

Gotheb. Wet. Sevensk. Handl., I, p. 70 (1778).

Typical locality.—Anjer, West Java.
Type.—Not in existence.

7785 imm. No locality; skin and skull.
♂ Tjibodas, Gedeh, 5,000 ft., West Java, 2nd March 1916; skin and skull (H. C. Robinson) [C.]; Federated Malay States Museum [P.].

Miller (*Proc. Biol. Soc., Washington*, XXIV, p. 28; 1911) has described from the above locality a mountain race of this species as *Ratufa bicolor major*, but the measurements of a large series do not confirm his conclusions and we have not therefore recognised his subspecies.

b. **bicolor baliensis,** Thos.

Ann. Mag. Nat Hist., (8), XI, p. 506 (1913).

Typical locality.—Tjetoekambawang, Bali.
Type.—In British Museum.

♀ Sodong Jerok, Idjen Massif, 3,900 ft., near Banjoewangi, East Java, 9th April 1916; Federated Malay States Museum [P.]; skin and skull.

Though originally described from Bali, this is merely the eastern Java form of the preceding and is the one on which Horsfield's descriptions have been founded.

c. **bicolor palliata** (Miller).

Proc. Acad. Nat. Sci. Philadelphia, LIV, p. 147 (1902).

Typical locality.—Indragiri River, East Sumatra.
Type.—In United States National Museum.

♂ Sungei Kumbang, Korinchi, West Sumatra, 4,500 ft.,11th April 1914. H. C. Robinson and C. B. Kloss [C.]; Federated Malay States Museum [P.]; skin and skull.

d. **bicolor laenata,** Miller.

Proc. U. S. Nat. Mus., XXVI, p. 459 (1903).

Typical locality.—Pulau Tuangku, Banjak Islands, West Sumatra.
Type.—In United States National Museum.

e. **bicolor batuana,** Lyon.

Proc. U. S. Nat. Mus., LII, p. 445 (1916).

Typical locality.—Tana Bala, Batu Islands, West Sumatra.
Type.—In United States National Museum.

Ratufa notabilis.

a. **notabilis notabilis,** Miller.

Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 150.

Typical locality.—Lingga Island, Rhio-Lingga Archipelago.
Type.—In United States National Museum.

b. **notabilis insignis,** Miller.

Smithsonian Misc. Coll., XLV, p. 4 (1903).

Typical locality.—Pulau Sugi, Rhio-Lingga Archipelago.
Type.—In United States National Museum.

c. **notabilis bulana,** Lyon.

Proc. U. S. Nat. Mus., XXXVI, p. 482 (1909).

Typical locality.—Pulau Bulan, Rhio-Lingga Archipelago.
Type.—In United States National Museum.

d. **notabilis carimonensis,** Miller.

Proc. U. S. Nat. Mus., XXXI, p. 257 (1906).

Typical locality.—Great Karimon Island, Rhio-Lingga Archipelago.
Type.—In United States National Museum.

♂ Tanjong Sebatak, Great Karimon Island, Rhio-Lingga Archipelago; 25th August 1908; E. Seimund [C.]; skin and skull. Federated Malay States Museum [P.].

e. **notabilis condurensis,** Miller.

Loc. cit. supra, p. 258.

Typical locality.—Pulau Kundur, Rhio-Lingga Archipelago.
Type.—In United States National Museum.

f. **notabilis confinis,** Miller.

Loc. cit. supra, p. 258.

Typical locality.—Sinkep Island, Rhio-Lingga Archipelago.
Type.—In United States National Museum.

g. **notabilis conspicua,** Miller.

Smithsonian Misc. Coll., XLV, p. 5 (1903).

Typical locality.—Pulau Bintang, Rhio-Lingga Archipelago.
Type.—In United States National Museum.

Ratufa ephippium.

a. **ephippium ephippium** (S. Muell.).

Tijd. Nat. Gesch. Physiol., V, p. 147 (1838-9).

Typical locality.—South-East Borneo (low country).
Type.—In Leyden Museum.

9549 (A. S. B.). Borneo (Batavian Society), 1844, imperfect skull.

It is of course impossible to allocate this specimen to any particular subspecies with any certainty, but from its data it is probably this race.

b. **ephippium cothurnata,** Lyon.

Proc. U. S. Nat. Mus., XL, p. 93 (1911).

Typical locality.—Mount Palung, near Sukadana, West Borneo.
Type.—In United States National Museum.

9544. Borneo (Alston); skin and skull.

c. **ephippium baramensis,** Bonh.

Ann. Mag. Nat. Hist., (7), V, p. 496 (1900).

Typical locality.—Baram district, Sarawak, Borneo.
Type.—In British Museum.

d. **ephippium sandakanensis,** Bonh.

Loc. cit. supra, p. 497.

Typical locality.—Sandakan, British North Borneo.
Type.—In British Museum.

9550. Borneo (Alston); skin and skull.

e. **ephippium griseicollis,** Lyon.

Proc. U. S. Nat. Mus., XL, p. 94 (1911).

Typical locality.—Panebangan Island, West Borneo.
Type.—In United States National Museum.

f. **ephippium vittata,** Lyon.

Loc. cit. supra, p. 94.

Typical locality.—Pulau Laut, South-East Borneo.
Type.—In United States National Museum.

g. **ephippium vittatula,** Lyon.

Loc. cit. supra, p. 95.

Typical locality.—Pulau Sebuku, South-East Borneo.
Type.—In United States National Museum.

h. **ephippium bunguranensis** (Thos. and Hart.).

Nov. Zool., I, p. 658 (1894).

Typical locality.—Bunguran Island, Natunas.
Type.—In British Museum.

i. **ephippium sirhassenensis,** Bonh.

Loc. cit. supra, p. 498.

Typical locality.—Sirhassen Island, Natunas.
Type.—In British Museum.

j. **ephippium nanogigas** (Thos. and Hart.).

Nov. Zool., II, p. 491 (1895).

Typical locality—Pulau Laut, North Natunas.
Type—In British Museum.

k. **ephippium polia,** Lyon.

Proc. U. S. Nat. Mus., XXXI, p. 585 (1906).

Typical locality.—Billiton Island.
Type.—In United States National Museum.

l. **ephippium bancana,** Lyon.

Loc. cit. supra, p. 587.

Typical locality.—Banka Island.
Type.—In United States National Museum.

Ratufa affinis.

a. **affinis affinis** (Raffles).

Trans. Linn. Soc., XIII, p. 258 (1822).

Typical locality.—Singapore.
Type.—Doubtfully in existence.

9545 ♀ Singapore (Rutledge) ; skull only.

The identification of this skull subspecifically is doubtful, but the specimen agrees with authentic examples from the type locality.

b. **affinis hypoleuca** (Horsf.).

Zool. Res. in Java (1824).

Typical locality.—Bencoolen, West Sumatra.
Type.—Doubtfully in existence.

9543. Java (Horsfield) [C.] *ex* India Museum, London ; skin and skull.

The localities attached to specimens from the old India Museum were notoriously incorrect, and I therefore am practically certain that the present one is incorrect, insomuch as no squirrel of this type is known from Java, neither Shortridge nor myself nor any recent collector having met with it.[1] I have therefore assigned it to the present race with the descriptions of which by Lyon and others it very fairly well agrees.

c. **affinis catemana,** Lyon.

Proc. U. S. Nat. Mus., XXXII, p. 443 (1907).

Typical locality.—Kateman river, South-East Sumatra.
Type.—In United States National Museum.

d. **affinis johorensis,** Robinson and Kloss.

Journ. Fed. Malay States Mus., IV, p. 244 (1911).

Typical locality.—Padang Tuan, Segamat, North-west Johore.
Type.—In Federated Malay States Museum.

e. **affinis aureiventer** (Is. Geoffr.).

Mag. Zool. Cl., I, pl. v (1832).

Typical locality.—Java (in error) substitute "Malacca."
Type.—In Mus. Nat. Hist., Paris.

9100, 9101. Nyalas Malacca, October, 1910 ; Federated Malay States Museum [P.] ; skins and skulls.
9542. Malacca (Alston) ; skin and skull.
9546-7, 9780 (A. S. B.). Malay Peninsula (E. Linstedt and R. W. G. Frith) [C.] 1846 ; imperfect skulls.
9548. [Java] (Mrs. Turnbull) 1857 ; skull.

[1] There is, however, one in the Leyden Museum labelled "Java Teysmann, 1878," *vide* Jentink, *Notes Leyden Mus.*, V, p. 112 (1883) under *Sciurus albiceps*, No. 29. It is not impossibly a much bleached example of *R. bicolor*.

The locality for this last skull must be erroneous. I have placed it under this form, but its subspecific identification is, of course, in the absence of the skin, rather uncertain.

f. **affinis arusinus,** Lyon.

Proc. U. S. Nat. Mus., XXXII, p. 442 (1907).

Typical locality.—Aru Bay, North-East Sumatra.
Type.—In United States National Museum.

g. **affinis pyrsonota,** Miller.

Proc. Acad. Sci. Washington, II, p. 75 (1900).

Typical locality.—Trang, Siamese Malaya.
Type.—In United States National Museum.

7071. Taiping, Perak, Malay Peninsula, 1889 (Mus. Coll.); skin and skull.

h. **affinis femoralis,** Miller.

Proc. U. S. Nat. Mus., XXVI, p. 447 (1903).

Typical locality.—Pulau Tuangku, Banjak Islands, West Sumatra.
Type.—In United States National Museum.

i. **affinis nigrescens,** Miller.

Op. cit. supra, p. 448.

Typical locality.—Pulau Mansalar, near Tapanuli Bay, West Sumatra.
Type.—In United States National Museum.

j. **affinis balae,** Miller.

Smithsonian Misc. Coll., XLV, p. 6 (1903).

Typical locality.—Tana Bala, Batu Islands, West Sumatra.
Type.—In United States National Museum.

k. **affinis masae,** Miller.

Op. cit. supra, p. 7.

Typical locality.—Tana Masa, Batu Islands, West Sumatra.
Type.—In United States National Museum.

l. **affinis piniensis** (Miller).

Op. cit. supra, p. 7.

Typical locality.—Pulau Pinie, Batu Islands, West Sumatra.
Type.—In United States National Museum.

Ratufa gigantea.

a. **gigantea gigantea** (McClell.).

P. Z. S., 1839, p. 150.

Typical locality.—Assam.

Type.—Formerly in the India Museum, London, but apparently no longer in existence.

9166. ♀ Upper Renging, Abor Hills, 2,150 ft. (Capt. de Courcy) [C.]; skin and skull.
9570-1. Naga Hills, Assam (A. W. Chennell) [C.]; skins and skulls.
9564. Garo Hills, Assam (Dr. J. Anderson) [C.], 1879; skin and skull.
9572. Telbongo Peak, Naga Hills, Assam (H. H. Godwin-Austen) [C.]; skin and skull.
9573-6. Dunsiris Valley, Assam, August 1873 (H. H. Godwin-Austen) [C.]; skin and skull.
9578-9, 9585. Sibsagar, Assam, July 1868 (S. E. Peel) [C.]; two skins and skulls.
9584 Juv. Goalpara, Assam, August 1868 (A. L. Haughton) [C.]; skin and skull.
9565-9, 9586. Samagooting, Assam (J. Butler) [C.]; skins and skulls.
9575. Assam, 1859 (Capt. E. F. Smith) [C.]; skin.
9303-5. Mangaldai, Assam (R. Frith) [C.]; skins.
9577. Dirjung River, North Cachar, May 1879 (H. H. Godwin-Austen) [C.]; skin and skull.
9580. Momein, Yunnan border, 6,000 ft., May 1868 (J. Anderson) [C.]; skin.
9591 Juv. Momein, Yunnan border, 6,000 ft., May 1868 (J. Anderson) [C.]; skin.
9583. Menagerie specimen (W. Rutledge) [P.]; skin and skull.
9582. [Borneo] (Alston); skin and skull.

The locality of the last specimen is certainly erroneous; no squirrel of this type is known to occur in Borneo. The tufted ears show that it is not one of the Malayan forms. The Momein skins though rather dark are quite typical; they too have tufted ears.

b. **gigantea lutrina,** Thos. and Wrought.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 226 (1916).

Typical locality.—West Bank of Upper Chindwin, Upper Burma.
Type.—In British Museum.

c. **gigantea macruroides** (Hodgs.).

Journ. Asiat. Soc. Bengal, XVIII, p. 775 (1849).

Typical locality.—Bengal.
Type.—In British Museum.

7297. ♀ Sukna, Darjiling Terai (W. Partridge) [C.]; skin and skull.
9563. ♀ Darjiling Terai, 1869 (J. Anderson) [C.]; skin and skull.
9560-1. ♂ ♀ Darjiling, 6,000 ft. (W. G. Masson) [C.]; skins and skulls.
9588. ♂ Darjiling, 8,000 ft. (W. G. Masson) [C.]; skin and skull.
9589. ♀ Darjiling, 8,000 ft. (W. G. Darling) [C.]; skin and skull.
9590. ♀ Rungbee, Darjiling (J. Munro) [C.]; skin and skull.
9562. ♂ Sikkim (H. J. Elwes) [E.]; skin and skull.
9574. ♂ Sikkim (W. T. Blanford) [C.]; skin and skull.
9551-9. Sikkim (L. Mandelli) [C.]; skin and eight skulls.

d. **gigantea fellii,** Thos. and Wrought.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 226 (1916).

Typical locality.—Yin, Lower Chindwin, Burma.
Type.—In British Museum.

9541. Pegu (W. T. Blanford) [C.]; skin and skull.

We are a little doubtful about this identification, but the small size of the skull, under 70 mm. in greatest length, induces us to place the

specimen, which is in faded pelage, under this race which appears to form a connecting link between *gigantea* and *melanopepla.*

e. **gigantea hainana,** Allen.

Bull. Amer. Mus. Nat Hist., XXII, p. 472 (1916).

Typical locality.—Cheteriang, Hainan.
Type.—In American Mus. of Natural History, New York.

Except for the fact that the single specimen obtained is stated to have tufted ears we should be inclined to place this race near the island forms of *R. melanopepla, viz., R. m. fretensis* and *R. m. penangensis.*

Ratufa phaeopepla.

a. **phaeopepla phaeopepla,** Miller.

Smithsonian Misc. Coll., LXI, p. 25 (1913).

Typical locality.—Sungei Balik, South Tenasserim.
Type.—In United States National Museum.

9534-5. Amherst, Tenasserim (Dr. J. Armstrong) [C.]; skins and skulls.
9529. Ye, Tenasserim, 1886 (G. M. Giles) [C.]; skin and skull.
9539 (A. S. B.). Tenasserim; skin and skull.
9540 Juv. (A. S. B.). Tenasserim (Major Berdmore) [C.]; skin and skull.
9592 (A. S. B.). Tenasserim, 1845 (F. Jenkins) [C.]; skin.
9530-1. ♂ ♀ Pilai, Elphinstone Island, Mergui, March, 1882 (Dr. J. Anderson) [C.]; skins and skulls.
9533. ♂ Mergui, December, 1881 (Dr. J. Anderson) [C.]; skin and skull.
9532. Thaing, King Island, Mergui, December, 1881 (Dr. J. Anderson) [C.]; skin and skull.

Nos. 9530-1 and to a less extent No. 9532 are not typical; the black is more intense on the upper surface and the rufous ferruginous colour below much richer, while the size is also rather large. They are probably referable to *R. m. calaenopepla,* Miller, or an undescribed form, but the material is not adequate for description or determination within very narrow limits.

b. **phaeopepla marana,** Thos. and Wrought.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 227 (1916).

Typical locality.—Mount Popa, Dry zone of Burma.
Type.—In British Museum.

9581. Upper Burma (Dr. Williams) [C.]; skin and skull.

c. **phaeopepla leucogenys,** Kloss.

Proc. Zool. Soc. London, 1916, p. 43.

Typical locality.—Lem Ngop, South-east Siam.
Type.—In British Museum.

d. **phaeopepla sinus,** Kloss.

Loc. cit. supra, p. 44.

Typical locality.—Koh Kut Island, South-east Siam.
Type.—In British Museum.

If *R. phaeopepla* is to be regarded as other than a subspecies of *R. melanopepla*, which is a very moot point, these two races are better classed as subspecies of it and not of *R. melanopepla* as has been done in the first instance.

Ratufa melanopepla.

a. **melanopepla melanopepla,** Miller.

Proc. Acad. Sci. Washington, II, p. 71 (1903).

Typical locality.—Telibon Island, Trang, Siamese Malaya.
Type.—In United States National Museum.

b. **melanopepla peninsulae,** Miller.

Smithsonian Misc. Coll., LXI, No. 21, p. 25 (1913).

Typical locality.—Lay Song Hong, Trang, Siamese Malaya.
Type.—In United States National Museum.

9538. ♂ Malay Peninsula (Rutledge); skull only.
♀ Ginting Bidai, Selangor, Malay Peninsula, 7th September, 1914; Federated Malay States Museum [P.]; skin and skull.

c. **melanopepla decolorata,** Robinson and Kloss.

Ann. Mag. Nat. Hist., (8), XIII, p. 227 (1914).

Typical locality.—Koh Samui Island, Bandon Bight, Siamese Malaya.
Type.—In Federated Malay States Museum.

♀ West side, Koh Samui, Bandon Bight, Siamese Malaya, 7th May, 1913 (H.C. Robinson) [C.]; Federated Malay States Museum [P.]; skin and skull.

d. **melanopepla celaenopepla,** Miller.

Smithsonian Misc. Coll., LXI, p. 26 (1913).

Typical locality.—Domel Island, Mergui Archipelago.
Type.—In United States National Museum.

e. **melanopepla fretensis,** Thos. and Wrought.

Ann. Mag. Nat. Hist., (8), IV, p. 535 (1909).

Typical locality.—Pulau Langkawi.
Type.—In British Museum.

♂ Sungei Udang, Pulau Terutau, Straits of Malacca, 9th March, 1909; Federated Malay States Museum [P.]; skin and skull.

f. **melanopepla penangensis,** Robinson and Kloss.

Journ. Fed. Malay States Museum, IV, p. 245 (1911).

Typical locality.—Telok Bahang, Penang Island.
Type.—In Federated Malay States Museum.

9536-7. No locality; skins and skulls.
These specimens agree perfectly with the types.
Telok Bahang, Penang Island, 11th March, 1911; one of the typical series. Federated Malay States Museum [P.]; skin and skull.

g. **melanopepla tiomanensis,** Miller.

Proc. Acad. Sci. Washington, II, p. 216 (1900).

Typical locality.—Pulau Tioman, South China Sea.
Type.—In United States National Museum.

♂ Juara Bay, Pulau Tioman, East Coast Malay Peninsula, 22nd June 1916 (H. C. Robinson). Federated Malay States Museum [P.]; skin and skull.

h. **melanopepla anambae,** Miller.

Proc. Acad. Sci. Washington, II, p. 215 (1900).

Typical locality.—Pulau Jimaja, Anamba Islands.
Type.—In United States National Museum.

i. **melanopepla angusticeps,** Miller.

Proc. Acad. Sci. Washington, III, p. 130 (1901).

Typical locality.—Pulau Lingung, Natuna Islands.
Type.—In United States National Museum.

sp. incert. sedis.

A mounted specimen of *Ratufa* from Ramree Island, Aracan, collected by Capt. Abbott in 1844 (Blyth Cat. *Sciurus bicolor* No. 309 D., p. 99 : Sclat. Cat. p. 9, *Sciurus bicolor typicus* spm. p.) is now, though in good external condition, bleached to a uniform liver brown above, hairs with no annulations, forehead slightly paler, grizzled, hands and feet white, tail above as body, paler at tip, the whole of the vertebral area beneath and the basal portion of the hairs white. Ears not tufted.

This specimen almost certainly represents a quite distinct undescribed form possibly allied to *R. g. lutrina*, but in view of the fact that it has been exposed to light for 75 years we do not care to describe it.

Genus **CALLOSCIURUS,** G. R. Gray, 1867.

Ann. Mag. Nat. Hist., (3), XX, p. 277 (1867).
Cf. Thomas, *op. cit.* (8), XV, p. 385 (1915).

Callosciurus erythraeus.

a. **erythraeus erythraeus** (Pallas).

Glires, p. 377 (1778).

Typical locality.— (?)
Type.— (?)

10196-10199, 10201, 10203, 1026. Above Tura, Garo Hills, Assam (S W. Kemp) [C]; skins and skulls.
9235-6. Garo Hills, Assam (Dr. J. Anderson) [C.]; skins and skulls.
9237. Garo Hills, Assam (H. H. Godwin-Austen) [C.]; skin and skull.
9238. Dorengo, Garo Hills (Museum Collector); skin and skull.
9239-40. (?) (A. W. Chennell) [C.]; skins and skulls.
9276. Shillong, Assam (T. La Touche) [C.]; skin and skull.
9274-75. Upper Burma; skulls only.

b. **erythraeus bhutanensis** (Bonhote).

Ann. Mag. Nat. Hist., (7), VII p. 161 (1901).

Typical locality.—Bhutan.
Type.—In British Museum.

The Indian Museum does not possess a specimen of this race which is of somewhat doubtful authenticity.

c. **erythraeus nagarum,** Thos.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 228 (1916).

Typical locality.—Sadiya, Assam.
Type.—In British Museum.

9241-4. East Naga Hills, August, 1875 (H. H. Godwin-Austen); skins and skull.
9249-52. 3 ♂ ♀ Naga Hills, December, 1875 (A. W. Chennell); skins and skulls.
9248. Samagooting, Assam (Capt. Butler) [C.]; skin and skull.
9245. ♂ Dinapur, Naga Hills, April, 1875 (H. H. Godwin-Austen) [C.]; skin and skull.
9246-7. ♂ ♀ (?) (Godwin-Austen) [C.]; skins and skulls.
9150. ♂ Between Kalek and Misshing, Abor Hills, March, 1912 (S. W. Kemp) [C.]; skins and skulls.
9157. ♂ Between Kalek and Misshing, Abor Hills, March, 1912 (S. W. Kemp) [C.]; (grading towards *C. e. intermedius*); skin and skull.
9153. ♀ Pasighat, Abor Hills, 400 ft., March, 1912 (S. W. Kemp) [C.]; skin and skull.

d. **erythraeus erythrogaster** (Blyth).

Journ. Asiat. Soc. Bengal, XI, p. 970 (1842).

Typical locality.—Manipur.
Type.—In Indian Museum.

9262 (A. S. B. 320a.). Manipur (Col. C. S. Guthrie) [C.]; type of the species; skin and skull. Also type of *Sciurus rufiventer*, Blyth (*nec* Desm., 1822), *Journ. Asiat. Soc. Bengal*, XVI, p. 871 (1847).
9253. "Assam" (A. W. Chennell) [C.]; skin and skull.
9254. ♂ Sylhet (Zoological Gardens); skin.
9256. Chittagong (J. M. Lister) [C.]; skin and skull.

e. **erythraeus punctatatissimus** (Gray).

Ann. Mag. Nat. Hist., (3), XX, p. 283 (1867).

Typical locality.—Cachar.
Type.—In British Museum.

9255. ♂ Sylhet (Zoological Gardens); skin and skull.

C. e. punctatatissimus differs from the preceding form by the exceedingly fine, almost obsolete, speckling of the upper surface and the darker chestnut of the belly. If this specimen and No. 9254 were really both got in exactly the same district it is evident that the present form is only a phase of *C. e. erythrogaster*, but having been a menagerie specimen the exact locality is open to much doubt.

f. **erythraeus intermedius** (Anderson).

Zool. and Anat. Res., p. 241 (1879).

Typical locality.—Assam.
Type.—In Indian Museum.

9260-1.[1] 2♂ Dikrang Valley, Assam (H. H. Godwin-Austen) [C.]; skins and skulls.
9263. ♂ Toruputu, Duffla Hills, Assam (H. H. Godwin-Austen) [C.]; skin and skull.
9264. ♀ (?) (H H. Godwin-Austen) [C.]; skin and skull.
9265, 9272. "Assam" (Dr. Day); skins and skulls.
9158. Sirpo Valley, Abor Hills (Capt. M. de Courcy); skin.
9156. ♀ Kobo, Abor Hills, 400 ft., December, 1911 (S. W. Kemp) [C.]; skin and skull.
9159-62. ♂ 3 ♀ Kobo, Abor Hills, 400 ft., December 1911 and March 1912; skins and skull.

Callosciurus erythraeus crotalius, Thos. and Wrought. (*Journ. Nat. Hist. Soc. Bombay*, XXIV, p. 227; 1916), types from Hkamti, Upper Chindwin, appears to be synonymous with this form, which, owing to the pernicious custom of describing species casually in the text, has largely escaped notice though the description is quite recognisable.

g. **erythraeus gordoni** (Anderson).

P. Z. S., 1871, p. 140.

Typical locality.—Bhamo, Upper Burma.
Types.—In Indian Museum.

9268. ♀ Bhamo, Upper Burma, February, 1868; Types; skin and skull.

9257. Bhamo, Upper Burma, September, 1868 (Dr. J. Anderson); Types; skin and skull.
9267. Bhamo, Upper Burma, February, 1868 (Dr. J. Anderson) [C.]; skin and skull.
9266. ♀ Bhamo, Upper Burma, February, 1868 (Dr. J. Anderson) [C.]; skin and skull.
9258-9. ♂ ♀ Bhamo, Upper Burma, March, 1875 (Dr. J. Anderson) [C.]; skins and skulls.
9270. ♂ Bhamo, Upper Burma, March, 1875 (Dr. J. Anderson) [C.]; skins and skulls.
9273, 77. 2♂ Second defile of Irrawaddy, Upper Burma, March, 1875 (Dr. J. Anderson) [C.]; skins and one skull.
9269. ♂ Sagaing, Upper Burma, October, 1868 (Dr. J. Anderson) [C.]; skin only.
9271. ♀ Sawaddy, Upper Burma, January, 1875 (Dr. J. Anderson) [C.]; skin and skull.

This squirrel varies in the intensity of the median grizzled streak on the belly, which is very much fainter in some specimens than in others. Two specimens shot in September have the under-surface pale yellowish instead of rusty chestnut.

h. **erythraeus kinneari,** Thos. and Wrought.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 229 (1916).

Typical locality.—Tathon, Kindat, Southern part of Upper Chindwin.
Type.—In British Museum.

[1] No particular specimen having been designated as the type by Dr. Anderson, I have fixed on No. 9260 as having a precise locality and sex attached. The form may be recognised by the absence of a grizzled median line on the belly and by having no black tip to the tail which has the terminal hairs broadly banded with yellowish-buff.

i. **erythraeus hyperythrus** (Blyth).

Journ. Asiat. Soc. Bengal, XXIV, p. 474 (1855).

Typical locality.—Tenasserim (? Moulmein).
Type.—In Indian Museum, Calcutta.

9478. Tenasserim, 1852 (Major Berdmore) [C.]; Type of the subspecies; skin and skull.

We are quite convinced that this subspecies, which has generally been referred to a "non-black-backed form of *C. atridorsalis*," comes in with *C. erythraeus* and *castaneiventris* and has nothing to do with *C. atridorsalis*. It is with difficulty separated from *C. e. rubeculus* (Miller) and *C. e. youngi* (Robinson and Kloss) principally by its deeper coloured belly, smaller size and absence of any trace of median ventral streak.

j. **erythraeus rubeculus** (Miller).

Typical locality.—Kao Sai Dao, Trang, Siamese Malaya.
Type.—In United States National Museum.

♂ Kao Nawng, Bandon, Siamese Malaya, 3,500 ft., June, 1913 (H.C. Robinson and E. Siemund) [C.]; Federated Malay States Museum [P.]; skin and skull.

k. **erythraeus youngi** (Robinson and Kloss).

Ann. Mag. Nat. Hist., (8), XIII, p. 225 (1914).

Typical locality.—Gunong Tahan, 5—6,000 ft., Northern Pahang.
Type.—In the Federated Malay States Museum.

♂ ♀ Wray's Camp, Gunong Tahan, 3,000ft., Northern Pahang, June and July, 1911 (H. C. Robinson and C. B. Kloss) [C.]; Federated Malay States Museum [P.]; skins and skulls.

l. **erythraeus castaneoventris** (Gray).

Ann. Mag. Nat. Hist., X, p. 263 (1842).

Typical locality.—"China" substitute Hainan.
Type.—In British Museum.

In 1910 Mr. R. C. Wroughton and one of us made the following note on this form. "*Sc. castaneoventris*" was described by Gray from a specimen collected by Mr. J. R. Reeves and labelled "China." Amongst the many varying allied forms from China in the Natural History Museum only one, *viz*., that from Hainan, at all resembles the type of *castaneoventris*; at first the strong resemblance was not very evident, but on washing the tail of the type specimen the characteristic long white tips of the hairs at the end became evident and there can be doubt that the form described by Allen as *Sc. erythraeus insularis* from Hainan is this form *sensu strictu*."

m. **erythraeus griseopectus** (Blyth).

Journ. Asiat. Soc. Bengal, XVI, p. 873 (1847).

Typical locality.—Unknown.
Type.—In Indian Museum, Calcutta.

9369. (Raja Mullick) [P.]; Type of the subspecies; skin only.

I do not know on what authority W. L. Sclater (*Cat. Mamm. Ind. Mus.*, II, p. 17 ; 1891) has given the locality China as the locality of this specimen which was unknown to its describer. The species, however, undoubtedly has the facies of the Chinese forms, and I cannot agree with Mr. Bonhote that it should be considered identical with *C. e. gordoni* (Anderson).

9370. Amoy, China, 1860 (R. Swinhoe) [C.]; skin and skull.
7370-1. Foochow, China, April, 1892 (R. Rickett) [C.]; skins and skulls.

These last three specimens are all rather richer coloured specimens than the type, probably to be accounted for by the age of the former, and have the median ventral stripe less in evidence, though this has been possibly obscured in skinning.

n. **erythraeus ningpoensis** (Bonh.).

Ann. Mag. Nat. Hist., (7), VII, p. 163 (1901).

Typical locality.—Ningpo, China.
Type.—In British Museum.

o. **erythraeus styani** (Thos.).

Ann. Mag. Nat. Hist., (6), XIII, p. 363 (1894).

Typical locality.—Between Shanghai and Hangchow.
Type.—In British Museum.

p. **erythraeus bonhotei** (Rob. and Wrought.).

Journ. Fed. Malay States Mus., IV, p. 234 (1911).

Typical locality.—Chen Chien San, Szechuen, China.
Type.—In British Museum.

q. **erythraeus michianus** (Rob. and Wrought.).

Loc. cit. supra, p. 235.

Typical locality.—Mee-Chee, Yunnan, South China.
Type.—In British Museum.

9058. ♂ Haikom, near Tengyueh, Yunnan, May, 1909 (J. Coggin Brown) [C]; skin and skull.

r. **erythraeus haemobaphes,** Allen.

Proc. Biol. Soc. Washington, XXV, p. 177 (1912).

Typical locality.—Chih-ping, South-East Yunnan.
Type.—In Museum of Comparative Zoology, Harvard, U. S. A.

s. **erythraeus thaiwanensis** (Bonh.).

Loc. cit. supra, p. 166.

Typical locality.—South Formosa (Baksa, October).
Type.—In British Museum.

t. **erythraeus centralis** (Bonh.).

Loc. cit. supra, p. 166.

Typical locality.—Lak-ku-li, Central Formosa.
Type.—In British Museum.

u. **erythraeus roberti** (Bonh.).

Loc. cit. supra, p. 166.

Typical locality.—North-West Formosa.
Type.—In British Museum.

I have inserted all three of these races from Formosa, but in view of the variability in the amount of chestnut on the underparts in *C. e. rubeculus*, I have strong doubts as to the validity of all, two being probably merely seasonal forms.

v. **erythraeus crumpi,** Wroughton.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 425 (1916).

Typical locality.—Sedonchen, Sikkim, 6500 ft.
Type.—In British Museum.

This species also is almost certain to possess a red-bellied summer form. (The type series were collected in November.)

Callosciurus sladeni.

a. **sladeni sladeni** (Anderson).

P. Z. S., 1871, p. 139.

Typical locality.—Thigyain, Upper Burma.
Type.—In Indian Museum.

9371. ♂ Thigyain, Upper Burma, 18th January, 1868 (J. Anderson) [C.]; Type of the species: skin and skull.
9374, 9783. ♂ Thigyain, Upper Burma, 18th January, 1868 (J. Anderson) [C.]; Type of the species: skin and 2 skulls.
9372-3 (A. S. B.). Upper Burma, 1864 (Dr. C. Williams) [C.]; skins and skulls.

The specimens collected by Dr. Williams, unfortunately without precise locality, show an approach to the succeeding form in having the ferruginous of the forehead less extensive. They are probably not strictly conspecific with Anderson's types but cannot be more precisely identified.

b. **sladeni midas** (Thos.).

Journ. Nat. Hist. Soc. Bombay, XXIII, p. 198 (1914).

Typical locality.—Myitkyina, Upper Burma.
Type.—In British Museum.

c. **sladeni rubex** (Thos.).

Loc. cit. supra, p. 198.

Typical locality.—Lonkin, Myitkina District, Upper Burma.
Type.—In British Museum.

d. **sladeni bartoni** (Thos.).

Loc. cit. supra, p. 198.

Typical locality.—Uyu River, 50 miles east of Homalin, Upper Chindwin.

Type.—In British Museum.

In a later paper (op. cit., XXIV, p. 234 ; 1916) Mr. Thomas expresses some doubts as to the distinctness of this form from true *sladeni.*

e. **sladeni shortridgei,** Thos. and Wrought.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 232, pl. fig. 1 (1916).

Typical locality.—Hkamti, Upper Chindwin.

Type.—In British Museum.

f. **sladeni fryanus,** Thos. and Wrought.

Op. cit. supra, p. 232, pl. fig. 2.

Typical locality.—Minsin, Upper Chindwin.

Type.—In British Museum.

g. **sladeni careyi,** Thos. and Wrought.

Op. cit. supra, p. 233, pl. fig. 3.

Typical locality.—Tamanthe, Upper Chindwin.

Type.—In British Museum.

h. **sladeni haringtoni** (Thos.).

Ann. Mag. Nat. Hist., (7), XVI, p. 314 (1905).

Typical locality.—Moungkan, Upper Chindwin.

Type.—In British Museum.

9970. No history ; skin only.

This specimen is to be referred to that form described as *Sc. haringtoni solutus*, Thomas (*Journ. Nat. Hist. Soc. Bombay*, XXIII, p. 199 ; 1914) which the author has later, on a revision of the whole group with large material, withdrawn (Thos. and Wroughton, *op. cit. supra*, p. 233, pl. fig. 4).

i. **sladeni millardi,** Thos. and Wrought.

Op. cit. supra, p. 233, pl. fig. 5.

Typical locality.—Pyaungbyin, 40 miles north of Kindat, Upper Chindwin.

Type.—In British Museum.

Callosciurus ferrugineus.

a. **ferrugineus ferrugineus** (F. Cuv.).

Hist. Nat. Mamm. III, pl. 238 (1829).

Typical locality.—Pegu.

Type.—In Mus. Hist. Nat., Paris.

9464. Rangoon (H. Fielden) [C.]; skin and skull.
9465-6 (A. S. B.). Burma, 1865 (Dr. C. Williams) [C.]; skins and skulls.
9469, 9470. ♀ Syriam, Pegu, 1876 (J. Armstrong) [C.]; skins and skulls.
9468 (A. S. B.). No history; skin and skull.
9467. No history (E. R. Alston) [P.]; skin and skull.

b. **ferrugineus cinnamomeus** (Temm.).

Esq. Zool. Guiné, p. 250 (1853).

Typical locality.—Cambodia.
Type.—In Leyden Museum.

c. **ferrugineus frandseni** (Kloss).

P. Z. S., 1916, p. 46.

Typical locality.—Koh Chang Island, South-east Siam.
Type.—In British Museum.

Callosciurus finlaysoni.

a. **finlaysoni finlaysoni** (Horsf.).

Zool. Res. Java, unpaged (1824).

Typical locality.—Koh Si Chang Islands.
Type.—In British Museum.

Sciurus finlaysoni portus, Kloss (*Journ. Nat. Hist. Soc. Siam*, I, p. 158; 1915) from the above locality is in the opinion of the senior author of this catalogue a pure synonym of this form (*cf.* Thomas, *Journ. Nat. Hist. Soc. Siam*, II, p. 343; 1917).

b. **finlaysoni folletti** (Kloss).

Journ. Nat. Hist. Soc. Siam, I, p. 159 (1915).

Typical locality.—Koh Phai, Inner Gulf of Siam.
Type.—In private possession.

c. **finlaysoni trotteri** (Kloss).

Journ. Nat. Hist. Soc. Siam, II, p. 178 (1916).

Typical locality.—Koh Lan Island, Inner Gulf of Siam.
Type.—In private possession.

d. **finlaysoni tachardi** (Robinson).

Journ. Fed. Malay States Mus., VII, p. 35 (1916).

Typical locality.—Krabin, Central Siam.
Type.—In private possession.

Callosciurus bocourti.

a. **bocourti bocourti** (A. Milne-Edw.).

Rev. Zool., p. 193 (1867).

Typical locality.—Ayuthia, Siam.
Type.—In Mus. Hist. Nat., Paris.

b. **bocourti harmandi** (A. Milne-Edw.).

Bull. Soc. Philomath., (6), XII, p. 8 (1876).

Typical locality.—Island Phu Quoc, off Chantabun.
Type.—In Mus. Hist. Nat., Paris.

c. **bocourti sinistralis** (Wroughton).

Ann. Mag. Nat. Hist., (8), II, p. 399 (1908).

Typical locality.—Pichit, Menam River, Central Siam.
Type.—In British Museum.

d. **bocourti dextralis** (Wroughton).

Loc. cit. supra, p. 400.

Typical locality.—Lower Me-Ping Valley, Siam.
Type.—In British Museum.

e. **bocourti lylei** (Wroughton).

Loc. cit. supra, p. 401

Typical locality.—Chiengmai, North Siam.
Type.—In British Museum.

f. **bocourti gruti** (Gyldenstolpe).

Kungl. Svenska Vet. Akad. Handl., LVII, No. 2, p. 37 (1917).

Typical locality.—Bang Hue Pong, North Siam.
Type.—In Natural History Museum, Stockholm.

g. **bocourti floweri** (Bonh.).

Ann. Mag. Nat. Hist., (7), VII, p. 455.

Typical locality.—Klong Morn (near Bangkok), Siam.
Type.—In British Museum.

We are unable to place this species with certainty but in all probability it is a form of *bocourti* and possibly in view of its locality quite identical with the typical race. Recent collectors do not appear to have met with it.

Callosciurus germaini.

a. **germaini germaini** (A. Milne-Edw.).

Rev. Zool., p. 193 (1867).

Typical locality.—Pulau Condor, off Cambodian coast.

Type.—In Mus. Hist. Nat., Paris.

9471. Pulau Condor (A. Germaine) [C.]; Museum of Natural History, Paris [E.]; A paratype of the species; skin and skull.

b. **germaini albivexilli** (Kloss).

P. Z. S., 1916, p. 47.

Typical locality.—Koh Kut Island, South-east Siam.
Type.—In British Museum.

c. **germaini nox** (Wroughton).

Ann. Mag. Nat. Hist., (8), II, p. 397 (1918).

Typical locality.—Sea coast, south-east of Bangkok, Siam.
Type.—In British Museum.

Collosciurus atrodorsalis.

a. **atrodorsalis atrodorsalis** (Gray).

Ann. Mag. Nat. Hist., X, p. 263 (1842).

Typical locality.—Bhutan (in error) substitute Moulmein.
Type.—In British Museum.

9330-4. South of Irrawaddy (T. H. Hood and Mus. Coll.); five skins only.
9335-9. Moulmein, March, 1873 (T. H. Hood); five skins only.
9360. Moulmein, March, 1873 (T. H. Hood); skin and skull.
9340-53. 3 ♀ Moulmein, October 1872 (T. H. Hood); 14 skins and 4 skulls.
9354. Moulmein, October 1873 (T. H. Hood); skin only.
9355. ♂ Moulmein, October 1872 (T. H. Hood); skin and skull.
9361-67. 2♂ 4♀ Moulmein, August 1872 (T. H. Hood) [C.]; 7 skins, 6 skulls.
9368. Skull only.
9357-8. Muleyit Range, Tenasserim; skins and skulls.
9356. Muleyit Range, Tenasserim, 1870 (J. Anderson) [C.]; skin and skull.
7592. Schwaygwyin, January 1898 (A. R. S. Anderson); skin and skull.

The large majority of these specimens are very typical, about half with the black back patch highly developed and nearly all with the vibrissae mainly yellowish-white. Those from Muleyit are much colder greyish-yellow above, the tail much less richly coloured and the vibrissae mainly black. Possibly they represent a seasonal phase or more probably another subspecies which for the present I prefer not to name. Nos. 9330, 9331 marked vaguely south of the Irrawaddy have the back patch obsolescent and the tail mainly black, though the others from the same locality are quite similar to those from Moulmein.

b. **atrodorsalis thai** (Kloss).

Journ. Nat. Hist. Soc. Siam, II, p. 285 (1917).

Typical locality.—Raheng, Central Siam.
Type.—In private possession.

The last four specimens recorded above are almost certainly to be referred to this form. Pending direct comparison we have however left them under the typical race as some doubt exists as to the seasonal phases of these squirrels.

c. **atrodorsalis shanicus** (Ryley).

Journ. Nat. Hist. Soc. Bombay, XXII, p. 603 (1913).

Typical locality.—Gokteik, North Shan States, Upper Burma.
Type.—In British Museum.

8431. Mong Ha, North Shan States, April 1907 (J. Coggin Brown) [C.]; skin and skull (fragments).

d. **atrodorsalis zimmeensis** (Rob. and Wrought.).

Journ. Fed. Malay States Mus., VII, p. 91 (1916).

Typical locality.—Chiengmai, North Siam.
Type.—In British Museum.

7595-6. Kolado, Salwin Hill tracts, Siamese border, January 1898 (Dr. A. R. S. Anderson) [C.]; skins and skulls.

At present I am inclined to regard these specimens as in the "eclipse" pelage of the above race though at one time both Mr. Wroughton and myself took the view that similar specimens from near the same locality represented yet another form.

Above a fairly uniform grizzle of black and buffy olivaceous more yellowish on the hands and feet. Sides of the face and back of the ears rufescent, vibrissae black. Tail regularly barred black and buffy ochraceous with an indication of a black tip. Beneath a drabby buff more rufescent in the axillary and inguinal region not very sharply defined from the sides.

e. **atrodorsalis tachin** (Kloss).

Journ. Nat. Hist. Soc. Siam, II, p. 178 (1916).

Typical locality.—Tachin, Central Siam.
Type.—In private possession.

f. **atrodorsalis pranis** (Kloss).

Loc. cit. supra, II, p. 178 (1916).

Typical locality.—Koh Lak, South-west Siam.
Type.—In private possession.

Callosciurus caniceps.

a. **caniceps caniceps** (Gray).

Typical locality.—Bhutan (erroneous) substitute North Tenasserim.
Type.—In British Museum.

9308-15. ♂ 2 ♀ Moulmein District, Lower Burma (T. H. Hood) [C.]; 9 skins and 2 skulls.
9474-7 (A. S. B.). Amherst, Tenasserim, 1846 (Revd. J. Barbe and E. O'Ryley) [P.]; Types of *Sciurus chrysonotus* (Blyth) (*Journ. Asiat. Soc. Bengal*, XVI, p. 873, pl. xxxvii, fig. 1; 1847); skins and skulls.
9329. No history; skin and skull.
7672. Probably Salwin Hill Tracts (A. R. S. Anderson) [C.]; skin only.

Comparison of these specimens and of others from Central and Western Siam in the possession of one of us have convinced us that the

form described as *Sciurus epomophorus fluminalis* by Wroughton and Robinson (*Journ. Fed. Malay States Mus.*, IV, p. 233; 1911) from the Meping Rapids, North Siam, is only this race in its dull pelage.

b. **caniceps davisoni** (Bonh.).

Ann. Mag. Nat. Hist., (7), VII, p. 273 (1901).

Typical locality.—Bankachon, South Tenasserim.
Type.—In British Museum.

9316. Mergui, Lower Burma, 1854 (Major Berdmore) [C.]; skin and skull.
9322-5. ♂, 2 ♀ Mergui, October and December 1881, and March 1882 (Dr. J. Anderson) [C.]; skins and skulls.

c. **caniceps inexpectatus** (Kloss).

Journ. Nat. Hist. Soc. Siam, II, p. 178 (1916).

Typical locality.—Koh Lak, South-west Siam.
Type.—In private possession.

d. **caniceps sullivanus** (Miller).

Smithsonian Misc. Coll., XLV, p. 17 (1903).

Typical locality.—Sullivan Island, Mergui Archipelago.
Type.—In United States National Museum.

9317. Lampei, Sullivan Island or King Island, Mergui (Dr. J. Anderson) [C.]; skin and skull.
9319. ♀ Padang Tebu, Sullivan Island or King Island, Mergui, February 1882 (Dr. J. Anderson) [C.]; skin and skull.
9318, 9320-1, 3. ♀ Pilai, Elphinstone Island, Mergui, March 1882 (Dr. J. Anderson) [C.]; skins and skulls.

The series listed under this race probably includes two forms but more precise identification is not feasible in view of the condition of the specimens.

e. **caniceps domelicus** (Miller).

Loc. cit. supra, p. 18.

Typical locality.—Domel Island, Mergui Archipelago.
Type.—In United States National Museum.

f. **caniceps bentincanus** (Miller).

Loc. cit. supra, p. 19.

Typical locality.—Bentinck Island, Mergui Archipelago.
Type.—In United States National Museum.

g. **caniceps matthaeus** (Miller).

Loc. cit. supra, p. 19.

Typical locality.—St. Matthew Island, Mergui Archipelago.
Type.—In United States National Museum.

h. **caniceps lucas** (Miller).

Loc. cit. supra, p. 20.

Typical locality.—St. Luke Island, Mergui Archipelago.
Type.—In United States National Museum.

i. **caniceps casensis** (Miller).

Op. cit. supra, p. 20.

Typical locality.—Chance Island, Mergui Archipelago.
Type.—In United States National Museum.

j. **caniceps altinsularis** (Miller).

Op. cit. supra, p. 21.

Typical locality.—High Island, Mergui Archipelago.
Type.—In United States National Museum.

k. **caniceps epomophorus** (Bonh.).

Ann. Mag. Nat. Hist., (7), VII, p. 272 (1901).

Typical locality.—Salanga or Junk Ceylon Island, Siamese Malaya.
Type.—In British Museum.

l. **caniceps milleri** (Robinson and Wroughton).

Journ. Fed. Malay States Mus., IV, p. 233 (1911).

Typical locality.—Trang, Siamese Malaya.
Type.—In British Museum.

♂ Lamra, Trang, Siamese Malaya, January 1910 (Mus. Coll.); skin and skull.
♀ Krongmon, Trang, Siamese Malaya, February 1910 (Mus. Coll.); Federated Malay States Museum [P.]; skin and skull.

m. **caniceps samuiensis** (Rob. and Kloss).

Ann. Mag. Nat. Hist., (8), XIII, p. 233 (1914).

Typical locality.—Koh Samui Bandon, Siamese Malaya.
Type.—In Federated Malay States Museum.

♂ ♀ Koh Samui Island, Bandon Bight, Siamese Malaya, May 1913 (H. C. Robinson and E. Siemund) [C.]; Federated Malay States Museum [P.]; skins and skulls.

n. **caniceps fallax** (Robinson and Kloss).

Tom. cit. supra, p. 225.

Typical locality.—Koh Pennan, Bandon, Siamese Malaya.
Type.—In Federated Malay States Museum.

♀ Koh Pennan Island, Bandon Bight, Siamese Malaya, May 1913 (H. C. Robinson and E. Siemund) [C.]; Federated Malay States Museum [P.] skins and skulls.

o. **caniceps lancavensis** (Miller).

Smithsonian Misc. Coll., XLV, p. 16 (1903).

Typical locality.—Pulau Langkawi, Straits of Malacca.
Type.—In United States National Museum.

♂ ♀ Pulau Langkawi, Straits of Malacca, February—March 1908 (Mus. Coll.); Federated Malay States Museum [P.]; skins and skulls.

p. **caniceps adangensis** (Miller).

Loc. cit. supra, p. 17.

Typical locality.—Pulau Adang, Butang Archipelago, Straits of Malacca.
Type.—In United States National Museum.

♀ Pulau Rawi, Butang Islands, Straits of Malacca, April 1911 (H. C. Robinson and E. Seimund) [C.]; skin and skull.
♂ Pulau Adang, Butang Archipelago, Straits of Malacca; Federated Malay States Museum [P.]: skin and skull.

q. **caniceps terutavensis** (Thos. and Wrought.).

Ann. Mag. Nat. Hist., (8), IV, p. 535 (1909).

Typical locality.—Pulau Terutau, Straits of Malacca.
Type.—In British Museum.

♂ ♀ Pulau Terutau, Straits of Malacca, December 1907 and February 1909 (H. C. Robinson) [C.]; Federated Malay States Museum [P.]; skins and skulls.

r. **caniceps concolor** (Blyth).

Journ. Asiat. Soc. Bengal, XXIV, p. 263 (1855).

Typical locality.—Malacca.
Type.—In Indian Museum, Calcutta.

9328. Malacca, 1847 (G. Moxon) [C.]; type of the sub-species; skin and skull.
9326-7. Perak (Mus. Coll.); skins and skulls.
9108-9. 2 ♀ Bukit Jong, Trengganu, September 1910 (C. B. Kloss) [C.]; skins and skulls.
9110, 9111. ♂ ♀ Bentong, Pahang (Mus. Coll.); skins and skulls.
9112. ♀ Nyalas, Malacca, October 1910 (Mus. Coll.); Topotype; skin and skull.
♂ Klang Gates, Selangor, January 1908 (Mus. Coll.); skin and skull.
♀ Telom, Perak-Pahang border, 3,500 ft., December 1908 (H. C. Robinson and C. B. Kloss) [C.]; Federated Malay States Museum [P.]; skin and skull.

Callosciurus griseimanus.

a. **griseimanus griseimanus** (A. Milne-Edw.).

Rev. Zool., 1867, p. 195.

Typical locality.—Cambodia.
Type.—In Mus. Hist. Nat., Paris.

b. **griseimanus leucopus** (Gray).

Ann. Mag. Nat. Hist., (3), XX, p. 282 (1867).

Typical locality.—Cochin China.
Type.—In British Museum.

9306-7. Cochin China (Julien) [C.]; Mus. Hist. Nat., Paris [E.]; skins and one skull.

c. **griseimanus vassali** (Bonh.).

P. Z. S., 1907, p. 9.

Typical locality.—Ninh Hoa, Annam.
Type.—In British Museum.

The relationship and pelage of this species, which is rare in collections, are by no means properly understood. It is by no means improbable that all three forms have one pelage in which the undersurface is more or less chestnut and another in which it is buff. The forms as named from such widely separated localities may nevertheless be expected to prove separable.

Callosciurus prevosti.

In view of the fact that there is an almost complete gradation from forms with a broad white stripe from nose to hip to others with no stripe at all, we have considered it more correct to regard all the races here listed as merely subspecies, though there is apparently a far greater difference between those occupying the extremes of the series, as for example *Sc. prevosti prevosti* and *Sc. p. pluto*, than there is between many others generally regarded as perfectly distinct species. Moreover, the arrangement has the practical convenience of bringing to the notice of the student at a glance what races have been described, whereas the use of binomial nomenclature such as is adopted by Miller and Lyon causes an unnecessary amount of labour in searching the literature.

So far as is known the large majority of forms in this group undergo no seasonal change of pelage nor does the pelage of the young differ materially from that of the adult, though Anderson in his monograph of the genus states the contrary. As with *Ratufa*, however, the pelage bleaches considerably generally on the back and tail, thereby occasionally obscuring differential characters. As a rule, however, there is little difficulty in determining the race to which a specimen should be assigned, the characters within the local limits being fairly constant, though in the case of the Bornean forms there appears to be some intergradation.

a. **prevosti prevosti** (Desm.).

Mamm., p. 335 (1822).

Typical locality.—Settlement of Malacca, Malay Peninsula.
Type.—In Mus. Hist. Nat., Paris.

♂ Nyalas, Malacca, 24th October, 1910; Federated Malay States Museum [P.]; skin and skull.
3653. Malacca (E. R. Alston) [P.]; skin.
9658. Malacca (A. Charlton) [C.]; skin and skull.
9659 (A. S. B.). Malacca (Revd. R. W. G. Frith) [C.]; skin and skull.
2948 (A. S. B.). ♀ Menagerie specimen (W. Rutledge) [P.]; skin and skull.

b. **prevosti wrayi** (Kloss).

Journ. Fed. Malay States Mus., IV, p. 148 (1910).

Typical locality.—Kuala Lipis, Pahang.
Type.—In British Museum.

♂ Temengoh, Upper Perak, Malay Peninsula, 12th July, 1909 (H. C. Robinson) [C.]; Federated Malay States Museum [P.]; skin and skull.

c. **prevosti humei** (Bonhote).

Ann. Mag. Nat. Hist., (7), VII, p. 170 (1901).

Typical locality.—Klang, Selangor, Malay Peninsula.
Type.—In British Museum.

♀ Tanjong Malim, Perak-Selangor boundary, Malay Peninsula, 19th April 1908; Federated Malay States Museum [P.]; skin and skull.

d. **prevosti rafflesii** (Vig. and Horsf.).

Zool. Journ., IV, p. 115, pl. iv (1828).

Typical locality.—Sumatra (probably Bencoolen).
Type.—In British Museum.

9657. Menagerie specimen (Zoological Garden, Calcutta); skin and [skull].
7529, 7880 [7487]. 2 ♀ Menagerie specimens (W. Rutledge) [P.]; skins and skulls.

e. **prevosti melanops** (Miller).

Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 151.

Typical locality.—Indragiri River, South-east Sumatra.
Type.—In United States National Museum.

7428, 7488. 2 ♂ Menagerie specimens (W. Rutledge) [P.]; skins and skulls.
7685, 7922. ♂ Menagerie specimens (Zoological Garden, Calcutta); skins and skulls.
7490-1, [7395] 7489. 2 ♂, 2 ♀ Menagerie specimens (W. Rutledge) [P.]; skins and skulls.

f. **prevosti penialius** (Lyon).

Proc. U. S. Nat. Mus., XXVI, p. 456 (1903).

Typical locality.—Pulau Penjalei, East Sumatra.
Type.—In United States National Museum.

g. **prevosti harrisoni** (Stone and Rehn.).

Proc. Acad. Nat. Sci. Philadelphia, 1902, p. 132.

Typical locality.—Gunong Sugi, Lampongs, South-east Sumatra.
Type.—In Coll. Acad. Nat. Sci., Philadelphia.

h. **prevosti condurensis** (Miller).

Proc. U. S. Nat. Mus., XXXI, p. 260 (1906).

Typical locality.—Pulau Kundur, Rhio-Lingga Archipelago.
Type.—In United States National Museum.

♀ Bliah, Pulau Kundur, Rhio-Lingga Archipelago, 22nd August 1908 (E. Seimund) [C.]; Federated Malay States Museum [P.].

i. **prevosti carimonensis** (Miller).

Loc. cit. supra, p. 261.

Typical locality.—Great Karimon Island, Rhio-Lingga Archipelago.
Type.—In United States National Museum.

♂ Pemeral, Great Karimon Island, Rhio-Lingga Archipelago, 13th August 1908 (E. Siemund) [C.]; Federated Malay States Museum [P.]; skin and skull.

j. **prevosti bangkanus** (Schlegel).

Ned. Tijd. Dierk., I, p. 26, pl. i, fig. 2 (1863).

Typical locality.—Bangka Island, East Sumatra.
Type.—In Leyden Museum.

k. **prevosti mendanauus** (Lyon).

Proc. U. S. Nat. Mus., XXXI, p. 589 (1906).

Typical locality.—Pulau Mendanau, West of Billiton.
Type.—In United States National Museum.

l. **prevosti carimatae** (Miller).

Proc. U. S. Nat. Mus., XXXI, p. 57 (1906).

Typical locality.—Karimata Island, off Bornean coast.
Type.—In United States National Museum.

m. **prevosti sanggaus** (Lyon).

Proc. U. S. Nat. Mus., XXXIII, p. 554 (1907).

Typical locality.—Sanggau, Western Borneo.
Type.—In United States National Museum.

n. **prevosti armalis** (Lyon).

Proc. U. S. Nat. Mus., XL, p. 821 (1911).

Typical locality.—Pulau Panebangan, West coast of Borneo.
Type.—In United States National Museum.

o. **prevosti pelapis** (Lyon).

Loc. cit. supra.

Typical locality.—Pulau Pelapis, West coast of Borneo.
Type.—In United States National Museum.

p. **prevosti borneoensis** (Mueller and Schlegel).

Verhandl., p. 86 (1839-44).

Typical locality.—Pontianak, Borneo.
Type.—In Leyden Museum.

9660. Borneo, 1844 (Batavian Society) [P.]; skin and [skull].

q. **prevosti palustris** (Lyon).

Proc. U. S. Nat. Mus., XXXIII, p. 552 (1907).

Typical locality.—North bank of Kapuas River, Western Borneo.
Type.—In United States National Museum.

r. **prevosti proserpinae** (Lyon).

Smithsonian Misc. Coll., XLVIII, p. 275 (1907).

Typical locality.—Pulau Ternajau, Western Borneo.
Type.—In United States National Museum.

s. **prevosti sarawakensis** (Gray).

Ann. Mag. Nat. Hist., XX, p. 277 (1867).

Typical locality.—Sarawak.
Type.—In British Museum.

t. **prevosti kuchingensis** (Bonhote).

Ann. Mag. Nat. Hist., (7), VII, p. 170 (1901).

Typical locality.—Kuching, Sarawak.
Type.—In British Museum.

9654. Matang, Sarawak, 1870 (E. R. Alston) [P.]; skin and skull.

u. **prevosti atricapillus** (Schlegel).

Ned. Tijd. Dierk., I, p. 27, pl. ii, fig. 1 (1863).

Typical locality.—Kapuas River, Western Borneo.
Type.—In Leyden Museum.

♂ Ulu Anyut, Paku Saribas, Sarawak, Borneo, 5th August 1915 (H. C. Robinson) [P.]; skin and skull.

v. **prevosti atrox** (Miller).

Smithsonian Misc. Coll., LXI, No. 21, p. 23 (1913).

Typical locality.—Talisaian Mountain, Dutch South-East Borneo.
Type.—In United States National Museum.

w. **prevosti caroli** (Bonhote).

Ann. Mag. Nat. Hist., (7), VII, p. 173 (1901).

Typical locality.—Baram, Borneo (low country).
Type.—In British Museum.

x. **prevosti griseicauda** (Bonhote).

Loc. cit. supra, p. 174.

Typical locality.—Mount Kalulong, Baram, Borneo.
Type.—In British Museum.

9655. "Borneo" (E. R. Alston) [P.]; skin and skull.

y. **prevosti erythromelas** (Temm.).

Esq. Zool. Guin., p. 248 (1853).

Typical locality.—Menado, North-West Celebes.
Type.—In Leyden Museum.

z. **prevosti schlegeli** (Gray).

Ann. Mag. Nat. Hist., XX, p. 278 (1867).

Typical locality.—Koma, Celebes.
Type.—In British Museum.

a[1]. **prevosti baluensis** (Bonhote).

Ann. Mag. Nat. Hist., (7), VII, p. 174 (1901).

Typical locality.—Mount Kina Balu, North Borneo. 1,000 ft.
Type.—In British Museum.

b[1]. **prevosti suffusus** (Bonhote).

Loc. cit. supra, p. 175.

Typical locality.—Tutong River, North-West Borneo.
Type.—In British Museum.

c[1]. **prevosti rufoniger** (Gray).

Ann. Mag. Nat. Hist., X, p. 263 (1842).

Typical locality.—Uncertain.
Type.—In British Museum.

d[1]. **prevosti pluto** (Gray).

Ann. Mag. Nat. Hist., XX, p. 283 (1842).

Typical locality.—Sarawak.
Type.—In British Museum.

9656. "Borneo" (E. R. Alston) [P.]; skin and [skull].

e[1]. **prevosti piceus** * (Peters).

Proc. Zool. Soc., 1866, p. 429.

Typical locality.—Uncertain.
Type.—In Berlin Museum.

* This species is attributed by the describer to Tenasserim which is certainly an erroneous locality. It was received at the museum with specimens of *Presbytes potenziani*, whose true locality has since been ascertained to be Mentawei Islands, off the Coast of Sumatra. The species was later described as *Sc. erebus*, Miller (*Proc. U. S. Nat. Mus.*, XXVI, p. 456; 1903) from Tapanuli Bay, North-West Sumatra, but the author now considers his specimens as identical with *S. piceus*.

f[1]. **prevosti nyx** (Miller).

Proc. U. S. Nat. Mus., XXXIV, p. 638 (1907).

Typical locality.—Pulau Rupat, East Sumatra.
Type.—In United States National Museum.

g[1]. **prevosti navigator** (Bonhote).

Ann. Mag. Nat. Hist., (7), VII, p. 171 (1901).

Typical locality.—Sirhassen, Natuna Islands.
Type.—In British Museum.

h[1]. **prevosti mimelus** (Miller).

Proc. Acad. Sci. Washington, II, p. 18 (1900).

Typical locality.—Pulau Wai, Tambelan Islands.
Type.—In United States National Museum.

i[1]. **prevosti mimiculus** (Miller).

Loc. cit. supra, p. 219.

Typical locality.—Sainte Barbe Island, South China Sea.
Type.—In United States National Museum.

The three preceding races are placed apart from the other forms of *prevosti* and are perhaps not in their proper sequence. They are very dwarfed forms inhabiting small islands but there is no reason to suppose that they are of any higher value than the other races listed.

Callosciurus vittatus.

a. **vittatus vittatus*** (Raffles).

Trans. Linn. Soc., XIII, p. 259 (1822).

Typical locality.—Bencoolen, West Sumatra.
Type.—In British Museum.

b. **vittatus saturatus** (Miller).

Proc. U. S. Nat. Mus., XXVI, p. 453 (1903).

Typical locality.—Pulau Mansalar, off Tapanuli Bay, West Sumatra.
Type.—In United States National Museum.

c. **vittatus pretiosus** (Miller).

Proc. U. S. Nat. Mus., XXVI, p. 454 (1903).

Typical locality.—Pulau Bangkaru, Banjak Islands, West Sumatra.
Type.—In United States National Museum.

* *Sciurus vittatus tarussanus*, Lyon (*Smiths. Misc. Coll.* XLVIII, p. 279; 1907) from Tarussan Bay, West Sumatra, is a pure synonym of this form.

d. **vittatus ubericolor** (Miller).

Proc. U. S. Nat. Mus., XXVI, p. 455 (1903).

Typical locality.—Pulau Tuangku, Banjak Islands.
Type.—In United States National Museum.

e. **vittatus tapanulius** (Lyon).

Smithsonian Misc. Coll., XLVIII, p. 280 (1907).

Typical locality.—Tapanuli Bay, West Sumatra.
Type.—In United States National Museum.

f. **vittatus peninsularis** (Miller).

Smithsonian Misc. Coll., XLV, p. 10 (1903).

Typical locality.—North bank of Endau River, South-East Pahang.
Type.—In United States National Museum.

g. **vittatus rupatius** (Lyon).

Proc. U. S. Nat. Mus., XXXIV, p. 640 (1908).

Typical locality.—Pulau Rupat, East Sumatra.
Type.—In United States National Museum.

h. **vittatus subluteus** (Thos. and Wrought.).

Ann. Mag. Nat. Hist., (8), III, p. 440 (1869).

Typical locality.—Si Karang, South-East Johore.
Type.—In British Museum.

♀ Tanjong Surat, Johore, 26th July 1908 (H. C. Robinson and E. Seimund) [C.]; Federated Malay States Museum [P.]; skin and skull.

i. **vittatus singapurensis** (Robinson).

Journ. Fed. Malay States Mus., VII, p. 73 (1916).

Typical locality.—Changi, Singapore Island.
Type.—In Federated Malay States Museum.

j. **vittatis maporensis** (Robinson).

Journ. Fed. Malay States Mus., VII, p. 64 (1916).

Typical locality.—Pulau Mapor, Rhio-Lingga Archipelago.
Type.—In Federated Malay States Museum.

k. **vittatus nesiotes** (Thos. and Wrought).

Ann. Mag. Nat. Hist., (8), III, p. 439 (1909).

Typical locality.—Pulau Batam, Rhio-Lingga Archipelago.
Type.—In British Museum.

l. **vittatus tenuirostris** (Miller).

Proc. Acad. Sci. Washington, III, p. 221 (1900).

Typical locality.—Tioman Island, off coast of Pahang.
Type.—In United States National Museum.

♂ ♀ Juara Bay, Pulau Tioman, South China Sea, 9th September 1907, 15th June 1912 (H. C. Robinson and E. Seimund) [C.]; Federated Malay States Museums [P.]; skins and skulls.

m. **vittatus anambensis** (Miller).

Proc. Acad. Sci. Washington, III, p. 223 (1900).

Typical locality.—Pulau Siantan, Anamba Islands.
Type.—In United States National Museum.

n. **vittatus abbottii** (Miller).

Typical locality.—Big Tambelan Island, South China Sea.
Type.—In United States National Museum.

o. **vittatus aoris** (Miller).

Smithsonian Misc. Coll., XLV, p. 10 (1903).

Typical locality.—Pulau Aor, near Pulau Tioman.
Type.—In United States National Museum.

♂ ♀ Pulau Aor, South China Sea, 12th June 1912, 14th June 1912 (H. C. Robinson and E. Seimund) [C.]; Federated Malay States Museum [P.]; skins and skulls.

p. **vittatus famulus** (Robinson).

Ann. Mag. Nat. Hist., (8), X, p. 592 (1912).

Typical locality.—Pulau Dayang, near Pulau Aor, South China Sea.
Type.—In Federated Malay States Museum.

♂ Pulau Dayang, near P. Aor, S. China Sea, 13th June 1912 (H. C. Robinson and E. Seimund) [C.]; Federated Malay States Museum [P.]; skin and skull.

q. **vittatus pannovianus** (Miller).

Smithsonian Misc. Coll., XLV, p. 11 (1903).

Typical locality.—Pulau Panau, Atas Islands, South China Sea.
Type.—In United States National Museum.

r. **vittatus pemangilensis** (Miller).

Smithsonian Misc. Coll., XLV, p. 9 (1903).

Typical locality.—Pemanggil Island, near Pulau Tioman.
Type.—In United States National Museum.

♂ ♀ Pulau Pemanggil, Johore Archipelago, 7th July, 12th July 1915 (H. C. Robinson) [C.]; Federated Malay States Museum [P.]; skins and skulls.

s. **vittatus ictericus** (Miller).

Smithsonian Misc. Coll., XLV, p. 12 (1903).

Typical locality.—Tana Bala, Batu Island, West Sumatra.
Type.—In United States National Museum.

t. **vittatus serutus** (Miller).

Proc. U. S. Nat. Mus., XXXI, p. 58 (1906).

Typical locality.—Pulau Serutu, Karimata Islands.
Type.—In United States National Museum.

u. **vittatus director** (Lyon).

Proc. U. S. Nat. Mus., XXXVI, p. 509 (1909).

Typical locality.—Direction Island, South China Sea.
Type.—In United States National Museum.

v. **vittatus lutescens** (Miller).

Proc. Acad. Sci. Washington, III, p. 124 (1901).

Typical locality.—Sirhassen Island, Natunas.
Type.—In United States National Museum.

w. **vittatus lamucotanus** (Lyon).

Proc. U. S. Nat. Mus., XL, p. 85 (1911).

Typical locality.—Pulau Lamukotan, West Borneo.
Type.—In United States National Museum.

x. **vittatus datus** (Lyon).

Loc. cit. supra, p. 86.

Typical locality.—Pulau Dato, West Borneo.
Type.—In United States National Museum.

y. **vittatus siriensis** (Lyon).

Loc. cit. supra, p. 87.

Typical locality.—Pulau Mata Siri, Java Sea.
Type.—In United States National Museum.

z. **vittatus arendsis** (Lyon).

Loc. cit. supra, p. 87.

Typical locality.—Arends Island, Java Sea.
Type.—In United States National Museum.

a^1. **vittatus marinsularis** (Lyon).

Loc. cit. supra, p. 89.

Typical locality.—Pulau Laut, off South-east Borneo.
Type.—In United States National Museum.

b[1]. **vittatus lautensis** (Miller).

Proc. Acad. Sci. Washington, III, p. 128 (1901).

Typical locality.—Pulau Laut, North Natuna Islands.
Type.—In United States National Museum.

c[1]. **vittatus rubidiventris** (Miller).

Proc. Acad. Sci. Washington, III, p. 127 (1901).

Typical locality.—Bunguran, Natuna Islands.
Type.—In United States National Museum.

d[1]. **vittatus rutiliventris** (Miller).

Proc. Acad. Sci. Washington, III, p. 126 (1901).

Typical locality.—Pulau Midei, South Natuna Islands.
Type.—In United States National Museum.

e[1]. **vittatus seraiae** (Miller).

Proc. Acad. Sci. Washington, III, p. 125 (1901).

Typical locality.—Pulau Seraia, Natuna Islands.
Type.—In United States National Museum.

f[1]. **vittatus albescens** (Bonh.).

Ann. Mag. Nat. Hist., (7), VII, p. 446 (1901).

Typical locality.—Acheen, North Sumatra.
Type.—In United States National Museum.

g[1]. **vittatus dulitensis** (Bonh.).

Ann. Mag. Nat. Hist., (7), VII, p. 451 (1901).

Typical locality.—Mount Dulit, Baram, Borneo.
Type.—In British Museum.

♂ Sungei Pelandok, Paku Saribas, Sarawak, October 1915 (Mus. Coll.); skins and skulls.
♀ Ulu Anyut, Paku Saribas, Sarawak (Mus. Coll.); skins and skulls.
♂ Kuala Selanoi, Paku Saribas, Sarawak (Mus. Coll.); skins and skulls.
9502. ♂ Sarawak (Wallace) [C]; skin and skull.

h[1]. **vittatus dilutus** (Miller).

Smithsonian Misc. Coll., LXI, No. 21, p. 23 (1913).

Typical locality.—Tanjong Batu, South-east Borneo.
Type.—In United States National Museum.

i[1]. **vittatus conipus** (Lyon).

Proc. Biol. Soc. Washington, XXIV, p. 98 (1911).

Typical locality.—Pamukang Bay, Southern Borneo.
Type.—In United States National Museum.

j[1]. **vittatus tedongus** (Miller).

Proc. U. S. Nat. Mus., XXXI, p. 591 (1906).

Typical locality.—Tanjong Tedong, Banka.
Type.—In United States National Museum.

k[1]. **vittatus billitonus** (Miller).

Proc. U. S. Nat. Mus., XXXI, p. 593 (1906).

Typical locality.—Buding Bay, Billiton.
Type.—In United States National Museum.

l[1]. **vittatus miniatus** (Miller).

Proc. Acad. Sci. Washington, II, p. 79 (1900).

Typical locality.—Trang, Siamese Malaya.
Type.—In United States National Museum.

9102. ♂ Chong, Trang, Siamese Malaya; Topotype of the species; skins and skull.
9103, 5, 6. ♂, 2 ♀ Bukit Jong, Trengganu, East Malay Peninsula; skins and skulls.
9104, 7. 2 ♀ Nyalas, Malacca; Federated Malay States Museum [P.]; skins and skulls.
9512. ♂ Zoological Gardens [P.]; skin only.
9510, 11. Malay Peninsula (E. Linstedt) [C.]; skins and skulls.
9509 (A. S. B.). Malay Peninsula (G. Moxon) [C.]; skin and skull.
9498. Malacca (F. Stoliczka) [C.]; skin and skull.
9503. ♂ (E. R. Alston) [P.]; skin and skull.
9504. ♂ (W. Rutledge) [P.]; skin and skull.
♀ Bukit Kutu, Selangor, 3,400 ft., August 1915 (C. B. Kloss) [C.]; Federated Malay States Museum [P.]; skin and skull.

m[1]. **vittatus scotti** (Kloss).

Ann. Mag. Nat. Hist., (8), XV, p. 117 (1911).

Typical locality.—Bedung Island, off Trengganu, East Malay Peninsula.

Type.—In Federated Malay States Museum.

♂ Redang Island, off Trengganu, East Malay Peninsula, August 1910; Paratype; skin and skull.

n[1]. **vittatus plasticus** (Kloss).

Loc. cit. supra, p. 117 (1911).

Typical locality.—Great Redang Island, off Trengganu, East Malay Peninsula.

Type.—In Federated Malay States Museum.

♂ ♀ Great Redang Island, off Trengganu, East Malay Peninsula; Paratypes; skins and skulls.

o[1]. **vittatus perhentiani** (Kloss).

Ann. Mag. Nat. Hist., (8), VII, p. 118 (1911).

Typical locality.—West Perhentian Island, off Trengganu, East Malay Peninsula.

Type.—In Federated Malay States Museum.

♂ ♀ West Perhentian Island, off Trengganu, East Malay Peninsula, September 1910 (C. B. Kloss) [C.]; Paratypes; Federated Malay States Museum [P.]; skins and skulls.

p[1]. **vittatus proteus** (Kloss).

Loc. cit. supra, p. 118 (1911).

Typical locality.—East Perhentian Island, off Trengganu, East Malay Peninsula.

Type.—In Federated Malay States Museum.

♂ ♀ East Perhentian Island, off Trengganu, East Malay Peninsula; skins and skulls.

q[1]. **vittatus watsoni** (Kloss).

Loc. cit. supra, p. 118.

Typical locality.—Lantinga Island, off Trengganu, East Malay Peninsula.

Type.—In Federated Malay States Museum.

♀ Lantinga Island, off Trengganu, East Malay Peninsula, September 1910; skin and skull.

Callosciurus notatus.

a. **notatus notatus** (Bodd.).

Elench. Mamm., p. 119 (1775).

Typical locality.—West Java.

Type.—Not in existence.

9500-1. West Java (A. R. Wallace) [C.]; skins and skulls.

b. **notatus madurae** (Thomas).

Ann. Mag. Nat. Hist., (8), V, p. 386 (1910).

Typical locality.—East part of Madura Island.

Type.—In British Museum.

c. **notatus balstoni** (Robinson and Wroughton).

Journ. Fed. Malay States Museum, IV, p. 234 (1911).

Typical locality.—South Central Java.

Type.—In British Museum.

d. **notatus stresemanni** (Thomas).

Ann. Mag. Nat. Hist., (8), XI, p. 505 (1913).

Typical locality.—Baleling, Bali.

Type.—In British Museum.

e. **notatus microtis** (Jentink).

Notes Leyden Museum, I, p. 40 (1879).

Typical locality.—Saleyer Island, Java Sea.
Type.—In Leyden Museum.

Callosciurus nigrovittatus.

a. **nigrovittatus nigrovittatus** (Horsf.).

Zool. Res. Java, (1824).

Typical locality.—Java (probably East central parts).
Type.—? In British Museum.

♂ ♀ Tjibodas, West Java, 5,000 ft., February 1916 (Mus. Coll.); Federated Malay States Museum [P.]; skins and skulls.

b. **nigrovittatus bilimitatus** (Miller).

Smithsonian Misc. Coll., XLV, p. 2 (1903).

Typical locality.—Tanjong Laboha, Trengganu, East Malay Peninsula.
Type.—In United States National Museum.

♀ Ulu Selama, North-East Perak, May 1909 (Mus. Coll.); Federated Malay States Museum [P.]; skin and skull.

c. **nigrovittatus johorensis** (Rob. and Wrought.).

Journ. Fed. Malay States Mus., IV, p. 167 (1911).

Typical locality.—Pelepak, Johore.
Type.—In British Museum.

9499. Malay Peninsula (Revd. J. Lindstedt) [C.]; skin and skull.
9505. ♀ Zoological Gardens; skin only.
9507-8. Malay Peninsula (G. Moxon) [C.]; skins and one skull.
♂ Batu Caves, near Kuala Lumpur, Selangor, January 1912 (Mus. Coll.); skins and skulls.
♀ Triang, North-West Pahang, September 1912 (Mus. Coll.); Federated Malay States Museum [P.]; skin and skull.
9506. Skull only.

d. **nigrovittatus microrhynchus** (Kloss).

Op. cit. supra, II, p. 144 (1908).

Typical locality.—Juara Bay, Pulau Tioman, Coast of Pahang.
Type.—In British Museum.

♂ ♀ Juara Bay, Pulau Tioman, Coast of Pahang, June, July 1915 (H. C. Robinson) [C.]; Topotypes; Federated Malay States Museum [P.]; skins and skulls.

e. **nigrovittatus bocki** (Rob. and Wrought.).

Journ. Fed. Malay States Mus., IV, p. 167 (1911).

Typical locality.—Pajo, Padang Highlands, West Sumatra.
Type.—In British Museum.

♂ ♀ Sungei Kumbang, Korinchi, 4,500 ft., West Sumatra, April, 1914 (H. C. Robinson and C. B. Kloss) [C.]; Federated Malay States Museum [P.]; skins and skulls.

f. **nigrovittatus orestes** (Thos.).

Ann. Mag. Nat. Hist., (6), V, p. 529 (1895).

Typical locality.—Mount Dulit, Baram, Borneo.
Type.—In British Museum.

Pending the statement of differential characters we cannot regard *Sciurus atristriatus*, Miller, described from a half-grown female from Lo Bon Bon, Dutch South-East Borneo [*Smithsonian Misc. Coll.*, No. 21, Vol. 61, p. 22 (1913)] as other than this form, which is not mentioned in the text and has possibly been overlooked by Mr. Miller.

g. **nigrovittatus klossii** (Miller).

Proc. Acad. Sci. Washington, II, p. 225 (1900).

Typical locality.—Saddle Island, Tambelan Group.
Type.—In United States National Museum.

Genus **TOMEUTES**, Thomas, 1915.

Ann. Mag. Nat. Hist., (8) XV, p. 386 (1915).

lokroides and **mearsi.**

This group is so difficult that fresh specimens properly dated and with measurements are required to deal with it satisfactorily. The specimens in the Indian Museum appear mainly to belong to two forms in winter and in summer pelage. Adequate material would doubtless enable separations to be made.

Tomeutes lokroides.

a. **lokroides lokroides** (Hodgson).

Journ. Asiat. Soc. Bengal, V, p. 232 (1836).

Typical locality.—Sikkim.
Type.—In British Museum.

8404-6. Khatmandu, Nepal (Major Manners-Smith).
9377. Below Bhimphed, Nepal (J. Scully); skin and skull.
9378. Hetowra, Nepal (J. Scully).
9381-2. Darjiling (W. T. Blanford); skins and skulls.
9384-6. Darjiling, 4,000 ft. (G. Masson); skins and skulls.
9393. Darjiling (J. Anderson); skin and skull.
9394, 9430. Darjiling (C. J. Bonieri); skins and skulls.
9431. Darjiling (E. Blyth); skin and skull.
7300. Sukna, 2,000 ft. (Base of Darjiling Himalayas); skin and skull.
9387-91. Darjiling (Terai) (J. Anderson); (9387, 90 skins and skulls).
9380. Sikkim (H. J. Elwes).
? Sikkim (H. J. Elwes).
9392. Sikkim Himalayas (J. Anderson); skin and skull.
9428. Sikkim (L. Mandelli); skin and skull.
9379. Sikkim (H. J. Elwes); skin and skull.
9437. Darjeeling (A. S. B.); skull only.
9438-9. ? (A. S. B.); skulls only.
9436. (A. Grote); skin and skull.

Black specimens juv. *germaini* ?
8042. ? ? skin and skull.
9383. Sikkim (L. Mandelli); skin and skull.

b. **lokroides owensi** (Thos. and Wrought.).

Journ. Bombay. Nat. Hist. Soc., XXIV, p. 336 (1916).

Typical locality.—Minsin (East Bank), Upper Chindwin.
Type.—In British Museum.

Tomeutes mearsi.

a. **mearsi mearsi** (Bonhote).

Ann. Mag. Nat. Hist., (7), XVIII, p. 338 (1906).

Typical locality.—Chinbyit, Lower Chindwin.
Type.—In British Museum.

b. **mearsi bellona,** Thos. and Wrought.

Journ. Bombay Nat. Hist. Soc., XXIV, p. 420 (1916).

Typical locality.—Kin, Middle Chindwin.
Type.—In British Museum.

10051. ♂ Rangamatti, Chittagong Hill Tracts (Mus. Coll.) ; skin and skull.

c. **mearsi virgo,** Thos. and Wrought.

Journ. Bombay Nat. Hist. Soc., XXIV, p. 421 (1916).

Typical locality.—Tatken, Upper Chindwin.
Type.—In British Museum.

10200, 12207-8. Above Tura, Garo Hills, Assam, 13-1400 feet, June 1917 (S. W. Kemp [C].
9398-9400. Garo Hills, Assam (Dr. J. Anderson) ; (9400 no skull) ; skin and skull.
9442 Nongjuri, Khasi Hills, Cherrapunji (B. Warren) ; skin and skull.
9432-3. Assam (Col. Jenkins) ; skins and skulls.
9418. Harmuth Dikrang, Assam (H. H. Godwin-Austen) ; skin and skull.
9407-9. Samagooting, Assam (Capt. Butler) ; skins and skulls.
9410-13 juv. Samagooting, Assam (Capt. Butler) ; (9413 hind foot only) ; skins and skulls.
9401-4, 9429. Naga Hills (H. H. Godwin-Austen) (9401 no skull) ; skins and skulls.
9405-6. Naga Hills (A. W. Chennell) ; skins and skulls.
942. Naga Hills (A. W. Chennell).
9414-7. Manipur Hills (H. H. Godwin-Austen) (9416-7 no skulls) ; skins and skulls.
9419. Bhamo, Burma (Dr. J. Anderson) ; skin and skull.
9395. Dacca (Mus. Coll.) ; skin and skull.
9396, 7. Lushai Country (Mus. Coll.) ; skins and skulls.
9434-5. Arakan (Sir A. Phayre) (9434 no skull).
9420, 2. Arakan (Mus. Coll.) ; (21, 22 no skulls).
9426-7. Amherst Isle, Arakan (J. Armstrong) ; skins and skulls.
9423. Jergo Isle, Arakan (Marine Survey) ; skin and skull.

subsp. nov. ?
9424. Preparis Island (V. Ball) ; skin and skull.
9425. Preparis Island (F. Stoticzka) ; skin only.

Tomeutes stevensi (Thomas).

Journ. Nat. Hist. Soc. Bombay, XVIII, p. 246 (1908).

Typical locality.—Beni-chang, Abor-Miri Hills, Upper Assam, 4,000.
Type.—In British Museum.

9139, 9140, 9143. 3 ♀ Balek, Abor Hills, March 1912 (S. W. Kemp) [C.]; skins and skulls.
9141, 9146. 2 ♀ Rotung, 1,300 ft., Abor Hills, March 1912 (S. W. Kemp) [C.]; skins and skulls.
9147. ♂ Between Kalek and Misshing, March 1912 (S. W. Kemp) [C.]; skin and skull.
9440. East Naga Hills (H. H. Godwin-Austen).

Tomeutes quinquestriatus (Anderson).

P. Z. S., 1871, p. 142, pl. x.

Typical locality.—Ponsee, Kakhyen Hills.
Type.—In Indian Museum, Calcutta.

9463. Ponsee, Kakhyen Hills, 3,200 ft., Yunnan Border, 24th February 1868 (J. Anderson) [C.]; Type of the species; skin and skull.
9461-2 and 10163. Ponsee, Kakhyen Hills, 3,200 ft., Yunnan Border, March and April 1868; skins and two skulls.
7558. No locality (Capt. E. Pottinger) [C.]; skin and skull.

Sciurus beebei, Allen (*Bull. Amer. Mus. Nat. Hist.*, XXX, p. 338; 1911) described from a single specimen without skull from Kuching, Sarawak, is obviously this species. It is significant that Mr. Beebe also obtained specimens of the true *quinquestratus* in the vicinity of the type locality so that some transposition of labels has evidently taken place.

Tomeutes phayrei.

a. **phayrei phayrei** (Blyth).

Journ. Asiat. Soc. Bengal, XXIV, pp. 472, 476 (1855).

Typical locality.—Sent from Moulmein.
Type.—In Indian Museum, Calcutta.

9300, 9301 (A. S. B. 330, 330c). Martaban, Lower Burma, 1861 (E. Blyth) [C.]; skins and skulls.
9302 (A. S. B. 330a). Martaban, Lower Burma, 1861 (E. Blyth) [C.]; skull only.
9473 (A. S. B. 330b). [Martaban, Lower Burma, 1861 (E. Blyth) [C.]]; skin and skull.

Though marked as from the above locality and date the specimen (No. 9473) which has once been mounted and now lacks its tail is probably the specimen sent by Sir A. Phayre (then Captain) to Blyth and is therefore the type of the species. In any event all four specimens mentioned above are lectotypes.

7593-4. ♂ ♀ Kollado, Salwin Hill Tracts, 22nd January, 1873; (Dr. A. R. S. Anderson) [C.]; skins and skulls.
10178. ♂ Heho, Southern Shan States, March 1917 (Dr. N. Annandale) [C.]; skin and skull.
10179, 10181-2. 2 ♂ 2 ♀ Fort Stedman, Southern Shan States, March 1917; (Dr. N. Annandale) [C]; skins and skulls.

b. **phayrei blanfordi** (Blyth).

Journ. Asiat. Soc. Bengal, XXXI, p. 333 (1862).

Typical locality.—Ava, Upper Burma.
Type.—In Indian Museum, Calcutta.

9298. ♂ Ava, Upper Burma (W. T. Blanford) [C.]; type of the subspecies; skin and skull.
9299. ♀ Pudeepyo, Upper Burma, 10th January 1875 (Dr. J. Anderson) [C.]; skin and skeleton.

The latter specimen shows faint indications of dark lateral bands.

Tomeutes pygerythrus.

a. **pygerythrus pygerythrus** (Is. Geoff.).

Mag. Zool. Cl. 1 (1832); Belanger, *Voyage Zool.*, p. 145, pl. vii (1847).

Typical locality.—Pegu.
Type.—In Mus. Hist. Nat., Paris.

9782 (A. S. B.). Lower Pegu (Berdmore) [C.]; skin and skull.
9284 (A. S. B.). Burma, 1865 (Dr. C. Williams) [C.]; skin and skull.
9285, 9286 (A. S. B.). Rangoon (Sir J. Fayrer) [C.]; skin only.
Rangoon (Sir A. Phayre) [C.]; skin and skull.
9287-90. 2 ♂ Rangoon, January 1876 (J. Armstrong) [C.]; skins and skulls.

b. **pygerythrus janetta** (Thos.).

Journ. Nat. Hist. Soc. Bombay, XXIII, p. 203 (1914).

Typical locality.—Mandalay, Upper Burma.
Type.—In British Museum.

10163. Mandalay, Upper Burma; skin and skull.
9291. Upper Burma, 1865 (Dr. C. Williams) [C.]; skin and skull.
9292-4. ♂ ♂ ♀ Sagaing, Upper Burma, October 1868 (Dr. J. Anderson) [C.]; skins and skulls.
9295-6. ♂ ♀ Ava, Upper Burma, October 1868 (Dr. J. Anderson) [C.]; skins and skulls.
9297. ♀ Kabuet, Upper Burma, January 1875 (Dr. J. Anderson) [C.]; skin and skull.

Agree well with the characters as given for this pale Upper Burma race by Thomas (*loc. cit. supra*).

Tomeutes hippurus.

a. **hippurus hippurus** (Is. Geoffr.).

Mag. de Zool., Cl. 8, No. 6, pl. vi (1832).

Typical locality.—Java (almost certainly erroneous); Malacca substituted.
Type.—In Mus. Nat. Hist., Paris.

9376 (A. S. B.). Malacca, 1844 (W. Frith); skin and skull.
♀ Taiping, Perak, September 1913; skin and skull.
♂ Bukit Tangga, 1,300 ft., Negri Sembilan, April 1914 (Mus. Coll.); Federated Malay States Museum [P.].

b. **hippurus hippurosus** (Lyon).

Smithsonian Misc. Coll., L, p. 26 (1907).

Typical locality.—Tarussan Bay, West Sumatra.
Type.—In United States National Museum.

c. **hippurus hippurellus** (Lyon).

Loc. cit. supra, p. 27.

Typical locality.—Batu Ampar, Landak River, West Borneo.
Type.—In United States National Museum.

d. **hippurus grayi** (Bonh.).

Ann. Mag. Nat. Hist., (7), VII, p. 171 (1901).

Typical locality.—Sarawak, Borneo.
Type.—In British Museum.

9375. Borneo (Dr. J. Anderson) [P.]; skin and skull.

Tomeutes pryeri.

a. **pryeri pryeri** (Thos.).

Ann. Mag. Nat. Hist., (6), X, p. 214 (1892).

Typical locality.—Near Sandakan, British North Borneo.
Type.—In British Museum.

b. **pryeri inquinatus** (Thos.).

Journ. Nat. Hist. Soc. Bombay, XVIII, p. 247 (1908).

Typical locality.—Lawas River, North-West Borneo.
Type.—In British Museum.

These two forms *hippurus* and *pryeri* do not appear to us to be naturally placed with *Tomeutes*. On external and cranial characters their alliances would seem rather with *Callosciurus prevosti*.

Tomeutes rubriventer (Forsten).

Mueller and Schlegel, *Verhandl. Nat. Gesch.*, p. 86 (1839-44).

Typical locality.—Minahassa, North Celebes.
Type.—In Leyden Museum.

Tomeutes melanogaster.

a. **melanogaster melanogaster** (Thos.).

Ann. Mus. Civ. Gen., XIV, p. 668 (1896).

Typical locality.—Sipora, Mentawei Ids., W. Sumatra.
Type.—In Genoa Museum; cotype in British Museum.

b. **melanogaster atratus** (Miller).

Smiths. Misc. Coll., XLV, p. 13 (1903).

Typical locality.—North Pagi Island, W. Sumatra.
Type.—In United States National Museum.

But for the fact that Thomas categorically states (*Ann. Mag. Nat. Hist.* (8), XV, p. 386 ; 1915) that the penis bone of these forms is that of *Tomeutes* we should have placed them as somewhat abnormal forms of *Callosciurus nigrovittatus.*

Tomeutes tenuis.

a. **tenuis tenuis** (Horsf.).

Zool. Researches in Java, 1824.

Typical locality.—Singapore Island.
Type.—In British Museum ; probably not now extant.

9457. Malacca (A. R. Wallace) [C.]; skin.
7075. ♀ Perak (Mus. Coll.) [C]; skin.

Perak specimens show an approach to the northern form *T. t. surdus* (Mill).

b. **tenuis surdus** (Miller).

Proc. Wash. Acad. Sci., II, p. 80 (1900).

Typical locality.—Trang, Siamese Malaya.
Type.—In United States National Museum.

c. **tenuis sordidus** (Kloss).

Ann. Mag. Nat. Hist., (8), VII, p. 119 (1911).

Typical locality.—Great Redang Island, off Trengganu, Eastern Malay Peninsula.
Type.—In Federated Malay States Museum.

d. **tenuis tiomanicus,** Robinson.

Journ. Fed. Malay States Museum, VII, p. 103 (1917).

Typical locality.—Tioman Island, East Coast, Malay Peninsula.
Type.—In Federated Malay States Museum.

e. **tenuis tahan** (Bonhote).

Journ. Fed. Malay States Museum, III, p. 6 (1908).

Typical locality.—Mount Tahan, Pahang, Malay Peninsula, 3,000 ft.
Type.—In British Museum.

f. **tenuis gunong** (Robinson and Kloss).

Journ. Fed. Malay States Museum, V, p. 119 (1914).

Typical locality.—Kao Nong, Bandon, Siamese Malaya, 3,000 ft.
Type.—In Federated Malay States Museum.

g. **tenuis modestus** (S. Müller).

Temminck's *Verhandelingen, Zoologie*, Inleidung, p. 55 (1839).

Typical locality.—Mount Singgalang, Sumatra, 3,000 ft.
Type.—In Leyden Museum.

h. **tenuis altitudinis** (Robinson and Kloss).

Journ. Straits Branch Roy. Asiat. Soc., No. 73, p. 270 (1916).

Typical locality.—Korinchi Peak, Sumatra, 7,300 ft.
Type.—In Federated Malay States Museum.

i. **tenuis mansalaris** (Miller).

Proc. U. S. Nat. Mus., XXVI, p. 451 (1903).

Typical locality.—Mansalar Island, West Sumatra.
Type.—In United States National Museum.

j. **tenuis batus** (Lyon).

Proc. U. S. Nat. Mus., LII, p. 443 (1916).

Typical locality.—Tana Bala, Batu Islands, West Sumatra.
Type.—In United States National Museum.

k. **tenuis bancarus** (Miller).

Proc. U. S. Nat. Mus., XXVI, p. 451 (1903).

Typical locality.—Bangkaru Island, Banjak Islands, West Sumatra.
Type.—In United States National Museum.

l. **tenuis pumilus** (Miller).

Smithsonian Miscellaneous Collections, XLV, p. 15 (1903).

Typical locality.—South Pagi Island, West Sumatra.
Type.—In United States National Museum.

m. **tenuis parvus** (Miller).

Proc. Biol. Soc. Washington, XIV, p. 33 (1901).

Typical locality.—Sarawak, Borneo.
Type.—In United States National Museum.

We are unable to precisely identify the following specimen on account of its poor condition.

9458. (329-A. S. B.) Java (Batavian Society) (P).

No squirrel of this type is known from Java; the present specimen probably came from South Borneo and is provisionally referred to this race.

Tomeutes lowii.

a. **lowii lowii** (Thomas).

Ann. Mag. Nat. Hist., (6), IX, p. 253 (1892).

Typical locality.—Sarawak, Borneo.
Type.—In British Museum.

b. **lowii bangueyae** (Thomas).

Ann. Mag. Nat. Hist., (8), V, p. 386 (1910).

Typical locality.—Banguey Island, North Borneo.
Type.—In British Museum.

c. **lowii natunensis** (Thomas).

Nov. Zool., II, p. 26 (1895).

Typical locality.—Sirhassen Island, Natuna Group, South China Sea.
Type.—In British Museum.

d. **lowii robinsoni** (Bonhote).

Fasciculi Malayenses, Zool., I, p. 24, pl. i (1903).
(Synonym *robinsoni alacris*, Thomas.)

Typical locality.—Bukit Besar, Patani, Malay Peninsula.
Type.—In British Museum.

e. **lowii humilis** (Miller).

Smithsonian Miscellaneous Collections, LXI, p. 24 (1913).

Typical locality.—Kateman River district, East Sumatra.
Type.—In United States National Museum.

f. **lowii vanakeni** (Robinson and Kloss).

Journ. Straits Branch Roy. Asiat. Soc., No. 73, p. 270 (1916).

Typical locality.—Barisan Range, Korinchi, Sumatra, 4,000 ft.
Type.—In Federated Malay States Museum.

g. **lowii piniensis** (Miller).

Smithsonian Miscellaneous Collections, XLV, p. 14 (1903).

Typical locality.—Pinie Island, Batu Group, West Sumatra.
Type.—In United States National Museum.

h. **lowii balae** (Miller).

Op. cit. supra, XLV, p. 14 (1903).

Typical locality.—Tana Bala Island, Batu Group, West Sumatra.
Type.—In United States National Museum.

i. **lowii seimundi** (Thomas and Wroughton).

Ann. Mag. Nat. Hist., (8), III, p. 440 (1909).

Typical locality.—Kundur Island, Rhio-Lingga Archipelago, East Sumatra.
Type.—In British Museum.

Tomeutes brookei (Thomas).

Ann. Mag. Nat. Hist., (6), IX, p. 253 (1892).

Typical locality.—Sarawak, Borneo.
Type.—In British Museum.

Tomeutes jentinki (Thomas).

Ann. Mag. Nat. Hist., XX, p. 128 (1887).

Typical locality.—Kinabalu, North Borneo.
Type.—In British Museum.

7233. Kinabalu (J. Whitehead) [C.]; skin and skull.

Tomeutes (?) helgei (Gyldenstolpe).

Kungl. Svenska Vet. Akad. Handl., LVII, No. 2, p. 34, pl. vi, figs. 3 and 4 (1917).

Typical locality.—South of Koh Lak, South-west Siam.
Type.—In Natural History Museum, Stockholm.

(Underparts slaty grey : greatest length of skull 50-51 mm. We are quite unable to place this form which is perhaps best regarded as a race of *Callosciurus caniceps*).

Genus **MENETES,** Thomas, 1908.

Menetes berdmorei.

a. **berdmorei berdmorei** (Blyth).

Journ. Asiat. Soc. Bengal, XVIII, p. 603 (1849).

Typical locality.—Thoungyeen District, Lower Burma.
Type.—Apparently not in existence unless the skull 9669 belongs to it.

9665-6. (A. S. B. 338a, b). Martaban, Burma (E. Blyth) [C.]; skins and skulls.
9667-8. ♂ ♀ Thaing, King Island, Mergui, January 1882 (Dr. J. Anderson) [C.]; skins and one skull.
9669. (?) Skull.
♂ Ban Kok Klap, Bandon, Siamese Malaya, July 4th, 1913 (H. C. Robinson) [C.]; Federated Malay States Museum.

b. **berdmorei amotus** (Miller).

Smithsonian Miscellaneous Collections, LXI, p. 24 (1913).

Typical locality.—Domel Island, Mergui Archipelago.
Type.—In United States National Museum.

c. **berdmorei koratensis** (Gyldenstolpe).

Kungl. Svenska Vet. Akad. Handl., LVII, No. 2, p. 39 (1917).

Typical locality.—Sakerat, near, Korat, Eastern Siam.
Type.—In Natural History Museum, Stockholm.

d. **berdmorei mouhoti**[1] (Gray).

P. Z. S., 1861, p. 137.

Typical locality.—Cambodia.
Type.—In British Museum.

e. **berdmorei decoratus** (Thomas).

Journ. Nat. Hist. Soc. Bombay, XXIII, p. 23 (1914).

Typical locality.—Mount Popa, Burma (dry zone).
Type.—In British Museum.

f. **berdmorei moerescens** (Thomas).

Loc. cit. supra, p. 24.

Typical locality.—Bali, near Nhatrang, Annam.
Type.—In British Museum.

g. **berdmorei consularis** (Thomas).

Loc. cit. supra, p. 24.

Typical locality.—Nan, Siam.
Type.—In British Museum.

h. **berdmorei umbrosus** (Kloss).

Proc. Zool. Soc. London, 1916, p. 49.

Typical locality.—Koh Chang Island, South-east Siam.
Type.—In British Museum.

i. **berdmorei rufescens** (Kloss).

Loc. cit. supra, p. 50.

Typical locality.—Koh Kut Island, South-east Siam.
Type.—In British Museum.

Genus **LARISCUS**, Thomas and Wroughton, 1909.

Proc. Zool. Soc. London, 1909, p. 389.

With the exception of *L. hosei*, which on account of its brilliant and striking colouration and the possession of four stripes on the back has strong claims to be regarded as specifically distinct, we have arranged all the races of this genus as subspecies of the original " *Sciurus insignis*, F. Cuv. " from Sumatra. All are closely allied to each other though it might be possible and convenient to regard *L. niobe* (Thomas) and *javanus* (Thomas and Wrought.) and possibly *rostratus* and *obscurus*, which we have not seen, as belonging to a different specific group.

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[1] Synonym : *Sciurus pyrrocephalus*, Milne-Edwards, *Rev. et Mag. de Zool.* (2), XIX, p. 225 (1867), Cochin China.

The genus is apparently confined to the Malay Peninsula and greater Sunda Islands and is not as yet known to occur within the limits of the Indian Empire or in Indo-China.

Lariscus insignis.

a. **insignis insignis** (Cuv.).

Mamm. pl. 233 (1818).

Typical locality.—Sumatra.
Type.—In Mus. Hist. Nat., Paris.

b. **insignis jalorensis** (Bonhote).

Fascic. Malay., Zool. I, p. 24 (1903).

Typical locality.—Jalor, North Malay Peninsula.
Type.—In British Museum.

9670. ♂ Malacca, Malay Peninsula (E. R. Alston) [P.]; skin and skull.
♀ Benom Foothills, Pahang, Malay Peninsula, 2nd November, 1913.
♀ Ayer Kring, Negri Sembilan-Pahang border, 17th March, 1918; skin and skull.
♂ Bukit Tangga, Negri Sembilan, Malay Peninsula, 13th January, 1914.
♂ Batu Tegor, Taiping, Perak, Malay Peninsula, 31st October, 1908; Federated Malay States Museum [P.].

c. **insignis meridionalis** (Robinson and Kloss).

Journ. Fed. Malay. States Mus., IV, p. 172 (1911).

Typical locality.—Changi, Singapore Island.
Type.—In British Museum.

d. **insignis fornicatus,** Robinson.

Op. cit. supra, VII, p. 102 (1917).

Typical locality.—Tioman Island, East Coast, Malay Peninsula.
Type.—In Federated Malay States Museum.

e. **insignis diversus** (Thomas).

Ann. Mag. Nat. Hist., (7), II, p. 248 (1898).

Typical locality.—Baram District, Borneo.
Type.—In British Museum.

f. **insignis castaneus** (Miller).

Proc. Acad. Sci. Washington, II, p. 217 (1900).

Typical locality.—Pulau Siantan, Anamba Islands.
Type.—In United States National Museum.

g. **insignis niobe** (Thomas).

Ann. Mag. Nat. Hist., (7), II, p. 249 (1898).

Typical locality.—Pajo, Highlands of West Sumatra.
Type.—In British Museum.

♀ Sungei Kumbang, Korinchi, West Sumatra, 15th April, 1914; Federated Malay States Museum (H. C. Robinson and C. B. Kloss) [C.]; skin and skull.

h. **insignis javanus,** Thomas and Wroughton.

P. Z. S. (Abstract) 1909, p. 19 ; *id., tom. cit.*, p. 38.

Typical locality.—Buitenzorg, West Java.
Type.—In British Museum.

.. Tjibodas, West Java, 29th February, 1916 (H. C. Robinson) [C.]; Federated Malay States Museum [P.]; skin and skull.

i. **insignis obscurus** (Miller).

Smithsonian Misc. Coll., XLV, p. 23, pl. i, fig. 2 (1903).

Typical locality.—South Pagi Island, West Sumatra.
Type.—In United States National Museum.

j. **insignis rostratus** (Miller).

Loc. cit. supra, p. 24.

Typical locality.—Tana Bala, Batu Islands, West Sumatra.
Type.—In United States National Museum.

Lariscus hosei (Thomas).

Ann. Mag. Nat. Hist., (6), X, pp. 215, 216 (1892).

Typical locality.—Mount Dulit, Baram District, Borneo.
Type.—In British Museum.

Genus **DREMOMYS,** Heude, 1898.

Mem. Hist. Nat. Empire Chinois, IV, pt. 2, p. 54 (1898).
Zetis, Thomas, *Journ. Nat. Hist. Soc. Bombay*, XVIII, p. 244 (1908).

Dremomys pernyi.

a. **pernyi pernyi** (Milne-Edw.).

Rev. et. Mag. de Zool., 1867, p. 230, pl. xix.

Typical locality.—Sze-chwan, China.
Type.—In Mus. Hist. Nat., Paris.

9138. Sirpo Valley, Abor Hills (Capt. I. Burn Murdoch) [C.] and [P.]; skin and skull.

b. **pernyi flavior,** Allen.

Proc. Biol. Soc. Washington, XXV, p. 178 (1912).

Typical locality.—South-east Yunnan.
Type.—In Museum of Comparative Zoology, Harvard, U. S. A.

c. **pernyi griselda,** Thos.

Ann. Mag. Nat. Hist., (8), XVII, p. 392 (1916).

Typical locality.—Western Sze-chwan (Nagchuka).
Type.—In British Museum.

d. **pernyi modestus,** Thos.

Loc. cit. supra, p. 393.

Typical locality.—Kwei-chow (Sui-yang), China.
Type.—In British Museum.

e. **pernyi senex,** Allen.

Mem. Mus. Harvard, XL, No. 4, p. 229 (1912).

Typical locality.—Ichang, China.
Type.—In Museum of Comparative Zoology, Harvard, U. S. A.

f. **pernyi chintalis,** Thos.

Loc. cit. supra, p. 394.

Typical locality.—An-hwei (Chinteh), China.
Type.—In British Museum.

g. **pernyi calidior,** Thos.

Loc. cit. supra, p. 394.

Typical locality.—North-West Fokien (Kuatun), China.
Type.—In British Museum.

Dremomys lokriah.

a. **lokriah lokriah** (Hodgs.).

Journ. Asiat. Soc. Bengal, V, p. 232 (1836).

Typical locality.—Nepal.
Type.—In British Museum. Co-type in Indian Museum, Calcutta.

9447. Nepal (Brian Hodgson) [C.]; India Museum, London [P.]; co-type of the species; skin and skull.
9443-5. 2 ♂, ♀ Sheopuri Ridge, Nepal Valley, February-June 1878 (J. Scully) [C.]; skins and skull.
9446. Sisagutu, Nepal, December 1877 (J. Scully) [C.]; skin and skull.
9448. Darjiling (Dr. J. Anderson) [C.]; skin and skull.
9450 (A. S. B. 327a.). Juv. Darjiling (Mrs. Oakes) [P.]; skin and skull.
9449. ♀ Sikkim (L. Mandelli) [C.]; skin and skull.
9453 Uncertain skull only.

b. **lokriah bhotia,** Thos.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 426 (1916).

Typical locality.—Sedonchen, East Sikkim.
Type.—In British Museum.

10202, 10204-5. ♂, ♀ Above Tura, Garo Hills, Assam, 3,900 feet, August 1917, (S. W. Kemp) [C.]; skins and skulls.
9451. Naga Hills (H. H. Godwin-Austen) [C.]; skin.
9452. Naga Hills (A. W. Chennell) [C.]; skin and skull.
9455. Shillong, Assam (T. la Touche) [C.] ; skin and skull.
9441. ♂ Nongjuri, Khasi Hills, Cherrapunji, Assam, May 1909 (B. Warren) [C.]; skin and skull.
9149. ♀ Komsing, Abor Hills, February 1912 (S. W. Kemp) [C.]; skin and skull.

These specimens which are more ochraceous and less ferruginous below than most specimens from Nepal have been referred to in the literature as *Sc. subflaviventris*, G. R. Gr. (*Hand-list Mamm. Brit. Mus.*, p. 144 ; 1843), a form which has never been properly described and must therefore be regarded as a *nomen nudum*.

Arakan specimens referred to this species by Blyth and others do not, so far as can be judged from the skins in the collection which are now in an excessively bad state of preservation, belong to this genus at all.

Dremomys macmillani (Thos.).

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 238 (1916).

Typical locality.—Kindat, Chindwin River, Upper Burma.
Type.—In British Museum.

Dremomys owstoni (Thos.).

Journ. Nat. Hist. Soc. Bombay, XVIII, p. 248 (1908).

Typical locality.—Mount Arizan, Central Formosa.
Type.—In British Museum.

Dremomys everetti (Thos.).

Ann. Mag. Nat. Hist., (6), VI, p. 171 (1890).

Typical locality.—Penrisen, Sarawak, Borneo.
Type.—In British Museum.

Dremomys rufigenis.

a. **rufigenis rufigenis** (Blanford).

Journ. Asiat. Soc. Bengal, XLVII (2), p. 156, pl. viii (1878).

Typical locality.—Mount Mooleyit, Central Tenasserim.
Type.—In British Museum. Co-type in Indian Museum.

7167. ♀ Mount Mooleyit, Central Tenasserim, 5,500 ft., January 1877 (W. Davison) [C.] ; skin and skull.

b. **rufigenis belfieldi** (Bonhote).

Journ. Fed. Malay States Mus., III, p. 9, pl. i (1908).

Typical locality.—Mountains of Selangor (4,800-5,800 ft.), Malay Peninsula.
Type.—In British Museum.

c. **rufigenis fuscus** (Bonhote).

P. Z. S. (Abstr.) 1907, p. 2 ; *P. Z. S. id.* 1907 (i), p. 10.

Typical locality.—Bali, Annam.
Type.—In British Museum.

d. **rufigenis adamsoni,** Thos.

Journ. Nat. Hist. Soc. Bombay, XXIII, p. 25 (1914).

Typical locality.—Maymyo, Upper Burma.
Type.—In British Museum.

e. **rufigenis ornatus,** Thos.

Loc. cit. supra, p. 26.

Typical locality.—Yunnan (?), near Mong-tze.
Type.—In British Museum.

f. **rufigenis opimus,** Thos.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 237 (1916).

Typical locality.—Hkamti, Upper Chindwin, Burma.
Type.—In British Museum.

8432. Mong-ha, North Shan States, Upper Burma, April, 1907 (J. Coggin Brown) [C.]; skin and skull.

This specimen agrees in colour more with this subspecies than with *D. r. adamsoni* but is smaller than the type specimen of *opimus*. It has the appearance of having been in spirit and we therefore prefer not to describe it. Greatest length of skull about 52 mm., agreeing with *adamsoni* in this respect, but much smaller than the Yunnan form. The specimen is adult but not old.

g. **rufigenis pyrrhomerus** (Thos.).

Ann. Mag. Nat. Hist., (6), XVI, p. 242 (1895).

Typical locality.—Ichang, China.
Type.—In British Museum.

h. **rufigenis riudonensis** (Allen).

Bull. Amer. Mus. Nat. Hist., XXII, p. 472 (1906).

Typical locality.—Riudon, Hainan.
Type.—In American Museum of Natural History, New York.

Genus **RHINOSCIURUS,** Gray, 1843.

Rhinosciurus laticaudatus.

a. **laticaudatus laticaudatus** (Muell. and Schleg.).

Verhandl., p. 100, pl. xv, figs. 1, 2, 3 (1839-44).

Typical locality.—Pontianak, Borneo.
Type.—In Leyden Museum.

b. **laticaudatus tupaioides**[1] (Blyth).

Journ. Asiat. Soc. Bengal, XXIV, p. 477 (1855).

Typical locality.—Malacca, Malay Peninsula.
Type.—In Indian Museum.

9664 (A. S. B.). Malacca, Malay Peninsula, 1851 (J. Moxon) [C.]; Type; skin only.
♂ Kao Nawng, Bandon, Siamese Malaya, 16th June 1913 (H. C. Robinson) [C.]; Federated Malay States Museum [P.]; skin and skull.
♂ Parit, Perak, 16th September 1911, Federated Malay States Museum [P.]; skin and skull.

c. **laticaudatus leo,** Thomas and Wroughton.

Ann. Mag. Nat. Hist., (8) III, p. 440 (1909).

Typical locality.—Changi, Singapore Island.
Type.—In British Museum.

d. **laticaudatus rhionis,** Thomas and Wroughton.

Loc. cit. supra, p. 441.

Typical locality.—Karimon Island, Rhio-Lingga Archipelago.
Type.—In British Museum.

e. **laticaudatus robinsoni,** Thomas.

Journ. Fed. Malay States Mus., II, p. 104 (1908).

Typical locality.—Tioman Island, East Coast, Malay Peninsula.
Type.—In British Museum.

♂ ♀ Juara Bay, Pulau Tioman, June-July 1915 (H. C. Robinson) [C.]; Federated Malay States Museum [P.]; skins and skulls.

f. **laticaudatus incultus,** Lyon.

Proc. U. S. Nat. Mus., LII, p. 444 (1916).

Typical locality.—Pulau Tuanku, Banjak Islands, West Sumatra.
Type.—In United States National Museum.

Genus **RHEITHROSCIURUS,** Gray, 1867.

Ann. Mag. Nat. Hist., XX, p. 272 (1867).

Rheithrosciurus macrotis (Gray).

P. Z. S., 1856, p. 341, pl. xlvi.

Typical locality.—Sarawak.
Type.—In British Museum.

Genus **GLYPHOTES,** Thomas, 1898.

Ann. Mag. Nat. Hist., (7), II, p. 251 (1898).

[1] *Rhinosciurus peracer*, Thos. and Wrought. (*Ann. Mag. Nat. Hist.* (8), III, p. 440; 1909) cannot be separated with certainty from this form.

Glyphotes simus, Thomas.

Op. cit. supra.

Typical locality.—Kinabalu, North Borneo.
Type.—In British Museum.

Genus **TAMIOPS,** Allen.

Bull. Amer. Mus. Nat. Hist., XXII, p. 475 (1906).

Tamiops macclellandi.

a. **macclellandi macclellandi** (Horsf.).

P. Z. S. 1839, p. 152.

Typical locality.—" Assam ".
Type.—In British Museum.

9671-4. Sikkim (L. Mandelli) [C.]; skins and skulls.
9675-6. Sikkim (H. J. Elwes) [E.]; skins and skulls.
9677. Rinok, Sikkim, 5,000 ft., Aug. 1870 (W. T. Blanford) [C.]; skin and skull.
9678. Darjiling (W. G. Masson) [P.]; skin and skull.
9679-80 (A. S. B. 344a, b.). Darjiling (Mrs. Cakes) [P.]; skins and skulls.
9681-82. ♂ Naga Hills (H. H. Godwin-Austen) [C.]; skins and skulls.
9683-5. East Naga Hills, August 1875 (H. H. Godwin-Austen) [C.]; skins and skulls.
9686. ♂ Near Peak 24, Naga Hills, February 1875 (H. H. Godwin-Austen) [C.]; skin and skull.

The specimen 9686 differs from all others of this race in having three distinct black stripes on the back, the lateral ones quite as well marked as the median one.

9687. ♂ Chota Naga Hills, December 1875 (A. W. Chennell) [C.]; skin and skull.
9688. ♀ Naga Hills, April 1876 (A. W. Chennell) [C.]; skin and skull.
9691-2. ♀ Duffla Hills, Assam (H. H. Godwin-Austen) [C.]; skin and skull.
9689-90. Asalu, North Cachar, May 1876 (H. H. Godwin-Austen) [C.]; skins and skulls.

One of these specimens (9690) in being lighter and greyer above shows an approach to the succeeding subspecies.

9135-6. ♂ Kobo, Abor Hills, 400 ft. (S. W. Kemp) [C.]; skins and skulls
9142 ♀ Rotung, Abor Hills, 1,300 ft. (S. W. Kemp) [C.]; skin and skull.

The types of *Sciurus pembertoni*, Blyth (*Journ. Asiat. Soc. Bengal*, XI, p. 887; 1842) from Bhutan, which is probably a pure synonym of this race, do not now appear to be in existence.

b. **macclellandi manipurensis** (Bonhote).

Ann. Mag. Nat. Hist., (7), V, p. 51 (1900).

Typical locality.—Aimole, Manipur.
Type.—In British Museum.

9693. Ponsee, Kakhyen Hills, 3,500 ft., Upper Burma (Dr. J. Anderson) [C.]; skin and skull.

Probably belonging to this form but the specimen is not in very good condition.

c. **macclellandi maritimus** (Bonhote).

Loc. cit. supra, p. 51.

Typical locality.—Foochow, China.
Type.—In British Museum.

7372. Foochow, China, April 1892 (C. B. Rickett) [C.]; (Topotype); skin and skull.

d. **macclellandi monticolus** (Bonhote).

Loc. cit. supra, p. 52.

Typical locality.—Ching Feng Ling, 2000 ft.
Type.—In British Museum.

e. **macclellandi formosanus** (Bonhote).

Loc. cit. supra, p. 52.

Typical locality.—North Formosa.
Type.—In British Museum.

9701. Formosa (R. Swinhoe) [C.], (A. R. Alston) [P.]; skin and skull.

f. **macclellandi barbei** (Blyth).

Journ. Asiat. Soc. Bengal, XVI, p. 875 (1847).

Typical locality.—Yé, Tenasserim.
Type.—In Indian Museum.

9482-3 (A. S. B. 343a, b.). Yé, Tenasserim (Revd. J. Barbe) [C.]; (types of the subspecies); skins and skulls.
9698 (A. S. B. 343c). Tenasserim (Major Berdmore) [C.]; skin and skull.
9694-7. Moulmein, October 1872 (Museum Collector) [C.]; skins and two skulls.

g. **macclellandi kongensis** (Bonhote).

P. Z. S., 1901 (i), p. 55.

Typical locality.—Raheng, Siam.
Type.—In British Museum.

9702. ♀ Yebok, 3,000 ft., Southern Shan States, December (Col. Bingham) [C.]; skin and skull.

If we are right in assigning the above specimen to this race its affinities are rather with the Malayan *novemlineatus* from which it differs only in the narrower internal pale stripes on the back than with *barbei* from Tenasserim All three forms are, however, exceedingly closely allied.

h. **macclellandi novemlineatus** (Miller).

Proc. Biol. Soc. Washington, XVI, p. 147 (1903).

Typical locality.—Trang, Siamese Malaya.
Type.—In United States National Museum.

9778. No history; skin and skull.
9018-19. ♂ ♀ Selangor-Pahang border, 4,000 ft., Malay Peninsula, October 1909 (F. M. S. Museum) [E.]; skins and skulls.
♀ Menuang Gasing, Ulu Langat, Selangor, 3,000 ft., 28th May 1911 (F. M. S. Museum [P.]; skins and skulls.
♂ Bukit Kutu, Ulu Selangor, 3,400 ft., 21st August 1915.

We have not used Temminck's name for this species [*Tamias leucotis*, Zool. sur la Cote de Guenée, p. 252 (1853)] as adopted by Bonhote seeing that as pointed out by Miller (*loc. cit.*) the description does not fit the Malayan animal.

There is no ambiguity about Miller's description and failing a re-examination of Temminck's type Miller's name has been adopted.

i. **macclellandi rodolphi** (Milne-Edwards).

Rev. et Mag. de Zool., XIX, p. 227 (1867)

Typical locality.—Cochin China.
Type.—In Paris Museum.

j. **macclellandi hainanus,** Allen.

Bull. Amer. Mus. Nat. Hist., XXII, p. 476 (1906).

Typical locality.—Lei-Mui Mon, Hainan (mountains).
Type.—In American Museum of Natural History, New York.

k. **macclellandi riudoni,** Allen.

Loc. cit., *supra*, p. 477.

Typical locality.—Riudon, Hainan (plains).
Type.—In American Museum of Natural History, New York.

l. **macclellandi sauteri,** Allen.

Op. cit., XXX, p. 339 (1911).

Typical locality.—Chip Chip, Northern Formosa.
Type.—In American Museum of Natural History, New York.

We are not acquainted with these three races and are therefore unable to place them in their correct positions; the last race is recorded as having been collected in the same place on the same dates as a series of *T. m. formosanus*.

Tamiops swinhoei (Milne-Edw.).

Rech. des. Mamm., p. 308 (1874).

Typical locality.—Moupin, China.
Type.—In Mus. Nat. Hist., Paris.

9700. Miwan, Kiangsi, China (Père David) [E.]; skin.
9699. Moupin, W. China (Père David); skin and skull.

This Chinese form is we think sufficiently distinct from the races of *T. macclellandi* to merit specific distinction.

The two specimens listed above from very widely separated localities are very different in appearance and probably represent distinct subspecies though possibly they are seasonal phases. That from Moupin has the dorsal stripes inconspicuous and almost obsolete, while the Kiangsi specimen has them very conspicuous, the two inner pale stripes being almost the colour of the back, while the outer ones are buff white. The three black stripes are broad and strongly marked.

Genus **FUNAMBULUS,** Lesson, 1836.

Funambulus palmarum.

a. **palmarum palmarum** (Linn.).

Syst. Nat., I, p. 86 (1766).

Typical locality.—Madras (by selection).
Type.—Not in existence.

9642-6. 3♂ 2♀ Madras Museum compound, 27th November, 1908 (Dr. N Annandale) [C.]; skins and skulls.
9636-41. 4♂, ♀ Shencottah, east side of Western Ghats, Travancore, 24th November, 1908 (Dr. N. Annandale) [C.]; skins and skulls.
9514 (A. S. B. 340A). Midnapur, Bengal (E. Blyth) [C.]; skin and skull.
9515 (A. S. B. 340B). Midnapur, Bengal (E. Blyth) [C.]; skin and skull.
9524. No history (Dr. Day); skin and skull.
9525. No history (Dr. Day) skin only.
9517. Trombay Island, Bombay, 28th January 1875 (H. H. Godwin-Austen) [C.]; skin and skull.
8081. ♂ Mandapan, Ramanad, South India (Dr. N. Annandale) [C.]; skin and skull.
9777. ♂ Kalakhul, February 1875; skin and skull.

b. **palmarum comorinus,** Wroughton.

Journ. Nat. Hist. Soc. Bombay, XVI. p. 411 (1905).

Typical locality.—Trivandrum, Travancore.
Type.—In British Museum.

9773-6. imm. Western side of Western Ghats, Travancore (Dr. N. Annandale) [C.]; skins snd skulls.

We are rather doubtful about the validity of this subspecies, which would appear to be confined to the western side of the Western Ghats, as specimens from Shencottah on the eastern side are richer in colour and smaller and agree closely with typical specimens from Madras.

We have, however, listed them under Wroughton's name as the largest specimen has a maximum skull length of 42 mm.

c. **palmarum bellaricus,** Wroughton.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 647 (1916).

Typical locality.—Vizayanagar, Bellary, South India.
Type.—In British Museum.

9792-5. Vizayanagar, Bellary, S. India, 1,500 feet. July 1912 (G. C. Shortridge) [C.]; skins and skulls.
9794. Houslayi, South Dharwar, South Mahratta Country, 2,000 feet, 18th February 1912 (G. C. Shortridge) [C.]; skin and skull.
9791. Dharwar, South Mahratta Country, 29th October 1911 (G. C. Shortridge) [C.]; skin and skull.
Bombay Nat. Hist. Soc. Mammal Survey [P.]

d. **palmarum favonicus,** Thos. and Wroughton.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 39 (1915).

Typical locality.—Udugama, Southern Province, Ceylon.
Type.—In British Museum.

e. **palmarum kelaarti** (Layard).

Blyth, *Journ. Asiat. Soc. Bengal*, XVIII, p. 602 footnote (1849), *id.*, *op. cit.*, XX, p. 166 (1852).

Typical locality.—Hambalotte, Ceylon.
Type.—In Indian Museum, Calcutta.

9479. Hambalotte, Ceylon (E. L. Layard) [C.]; skin and portions of skull.

This specimen is evidently Layard's type but is so deteriorated that but little can be made out of it. The head to level of ears is ferruginous and the dorsal stripes very clearly defined and rather broad, the central one narrower. The face, however, does not appear to be ferruginous as stated in Thomas and Wroughton's key (*loc. cit. supra.*).

9523. Ceylon (Colombo Mus.) [P.]; skin and skull.

This specimen agrees with the above type but has the ferruginous cap not quite so pronounced. All three back stripes buffy white, the median one paler. Midrib of tail rufous nearly to the tip.

f. **palmarum brodiei** (Blyth).

Journ. Asiat. Soc. Bengal, XVIII, p. 602 (1849).

Typical locality.—Point Pedro, Ceylon.
Type.—In Indian Museum, Calcutta.

9480. Point Pedro, Ceylon (E. L. Layard) [C.]; type of the subspecies; skin and imperfect skull.

Not much can be made out of this specimen which has been exposed to light mounted in a gallery for 60 years.

9522. Ceylon (Dr. Kelaart) [C.]; skin and fragmentary skull.

g. **palmarum olympius,** Thos. and Wrought.

Op. cit. supra, p. 41.

Typical locality.—Unugalla, Highlands of Central Ceylon.
Type.—In British Museum.

9521 (A. S. B.). Ceylon (R. Templeton); skin and fragmentary skull, also another skull with this number.

This specimen recorded by W. L. Sclater (*Cat. Mamm. Ind. Mus.*, II, p. 25; 1891) as one of the types of *F. p. kelaarti* is obviously not so. It is, allowing for deterioration in both specimens, a much darker, richer coloured specimen than Layard's type, with broader buffy stripes and with no ferruginous cap. We have therefore assigned it to this race.

h. **palmarum robertsoni** (Wroughton).

Loc. cit. supra, p. 647.

Typical locality.—Pachmarhi, Hosengabad, Central Provinces.
Type.—In British Museum.

9793-6. Pachmarhi, Hosengabad, Central Provinces, 3,000 feet, March 1912, skins and skulls: Topotypes.
C. M. Crump [C.]; Bombay Nat. Hist. Soc. Mamm. Survey [P.]

i. **palmarum bengalensis** (Wroughton).

Loc. cit. supra, p. 648.

Typical locality.—Hazaribagh, Bengal (now Bihar).
Type.—In British Museum.

The specimens from Midnapur, listed above under *F. palmarum palmarum*, presumably belong to this form but for the present we prefer to leave them under the original name as we have not been able to compare them with the description.

Funambulus pennanti.

a. **pennanti argentescens,** Wroughton.

Journ. Nat. Hist. Soc. Bombay, XVI, p. 413 (1905).

Typical locality.—Rawalpindi.
Type.—In British Museum.

10210. ♂ Rawalpindi, Punjab, June 1917 (R. A. Hodgart) [C.]; skin and skull.
9618. ♀ Pishin, Persian Baluchistan, 7th February 1872 (W. T. Blanford) [C.]; skin and skull.
9799. ♂ Bhuj, Cutch, 1st August 1911 (C. H. Crump) [C.]; Bombay Nat. Hist. Soc. Mammal Survey [P.]; skin and skull.

Though Mr. Wroughton (*Journ. Bombay Nat. Hist. Soc.*, XXI, p. 839; 1912) has identified this last specimen as typical *F. p. pennanti*, it must, we think on account of its pale colour, small size and narrowed skull, be regarded as belonging to this desert form.

b. **pennanti lutescens,** Wroughton.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 429 (1916).

Typical locality.—Deesa, Palanpur.
Type.—In British Museum.

c. **pennanti pennanti,** Wroughton.

Typical locality.—Mandvi Taluka, Surat District, Bombay.
Type.—In British Museum.

9635. ♂ Agra Fort, 10th January 1908 (R. A. Hodgart) [C.]; skin only.
9631-3. ♂, 2♀ Lucknow, 17th January 1908 (R. A. Hodgart) [C.]; skins and two skulls.
9630, 8433, 8435. 2♂, ♀ Bareilli, March 1907; skins and skulls.
9634, 8434, 8436. 3♀ Bijnor, January 1907 (R. A. Hodgart) [C.]; skins and skulls.
9619. Bichiakoh, Nepal Terai, 21st December, 1877 (J. Scully) [C.]; skin and skull.
9622-6. 3♂ Calcutta, 1869-70 (J. Anderson) [C.]; skins and skulls.
9493-6. ♂, 3♀ Calcutta, August, 1911 (R. A. Hodgart) [C.]; skins and skulls.
7562 imm. Albino, Calcutta; skin and skull.
9652. Sita Nullah, Paresnath Hill, Bengal, 11th April 1909 (Drs. N. Annandale and J. T. Jenkins) [C.]; skin and skull.
9649-51. 2♂ Balur, Lower Bengal, November 1908 (J. Caunter) [C.]; skins and skulls.
9620-1. 2♂ Manbhoom, Bengal (Mus. Coll.); skin and one skull.
9516. Ranchi, Chota Nagpur, May 1870 (W. T. Blanford) [C.]; skin.

These last three specimens are unusually dark with the final lateral light stripe poorly developed. They probably represent a distinct form as yet unnamed.

9647-8. 2♀ Balighai, Puri District, Orissa, 23rd October 1908 (Dr. N. Annandale) [C.]; skins.
9497. ♂ Balighai, Puri District, Orissa, 17th August 1911 (Dr. N. Annandale and F. H. Graveley) [C.]; skin and skull.
9046. Rambha State, Lake Chilka, Ganjam District (Dr. N. Annandale) [C.]; skin and skull.

These four specimens come from the meeting place of *pennanti* and *palmarum* and while one is indisputably the former race, the last-mentioned skin would, but for its locality, be assignable to the latter. Perhaps there has been some transposition of labels.

9628. Hyderabad, 1855 (Dr. H. Gould) [P.]; a sandy coloured form, by no means typical; skin only.
9629. No locality (E. R. Alston); skin and skull.
9627. ♀ Chanda, Central Provinces, 6th May 1867 (Mus. Coll.); skin and skull.
9798. ♂ Chanda, Central Provinces, 800 ft., June 1912; skin and skull.
9797. ♀ Chichpalli, Chanda, Central Provinces, June 1912, 1,300 ft. (C. M. Crump) [C.]; Bombay Nat. Hist. Soc. Mammal Survey [P.]; skin and skull.

Funambulus tristriatus.

a. **tristriatus tristriatus** (Waterh.).

Charlesworth's *Mag. Nat. Hist.*, I, pp. 496-9 (1837).

Typical locality.—Non-cited. Madras by subsequent designation.
Type.—In British Museum.

9800. Dharwar, South Mahratta Country, 31st October 1911; skin and skull.
9803. Devikop, South Mahratta Country, 2,000 ft., 27th November 1911; skin and skull.
9801. Sirsi, Kanara, 1,500 ft., 6th April 1912; skin and skull.
9802. Potoi, North Kanara, 1,800 ft., 18th January 1912 (G. C. Shortridge) [C] Bombay Nat. Hist. Soc. Mammal Survey [P.]; skin and skull.
9518. Kalakhul (H. H. Godwin-Austen) [P.]; skin only.
9528. No history; skin only.
9526. No history; skin only.
9520, 9519. Travancore (probably eastern side of the Ghats); skins only.

b. **tristriatus numarius,** Wroughton.

Journ. Nat. Hist. Soc. Bombay, XXIV, p. 646 (1916).

Typical locality.—Helwak, Satara Dist., W. Ghats, Bombay.
Type.—In British Museum.

c. **tristriatus,** subsp. nov ?

9513. Sikkim (H. J. Elwes) [E.]; skin only.

This specimen is obviously subspecifically distinct from others of the group but as there is no skull or measurements we prefer not to name it. It differs from all others of the group in the great reduction of the longitudinal white stripes on the back, the median one being almost obsolete. The general colour above is darker and the "saddle" is not specially marked. It is possible that it is not referable to this genus at all but in the absence of a skull nothing can be definitely stated.

d. **tristriatus annandalei,**[1] Robinson.

Rec. Ind. Mus. XIII, p. 41 (1917).

Type.—Adult female. Indian Museum No. 8498, skin and skull (lower mandible missing), collected at Shasthancotta, west side of Western Ghats, Travancore, on 8th November 1908, by Dr. N. Annandale.

Diagnosis.—A large richly coloured form allied to *F. t. tristriatus* (Waterh.), but larger, smaller than *F. wroughtoni*, Ryley, from Coorg.[2] Longitudinal stripes on back narrow, whitish, traceable to neck. Saddle black, tail with white tips to hairs exceptionally well developed, anal region and midrib to tip rich chestnut.

Colour.—Head and cheeks to behind the eye ferruginous, speckled with black, richest on top of head ; rest of upper surface speckled black greyish and fulvous, the rump with a strong ferruginous suffusion, the longitudinal stripes almost pure white, narrow and well defined except on the back of the neck, " saddle " almost pure black ; hands speckled greyish-black, feet with a more fulvous tint. Tail black, with broad white tips to the hairs and a buff basal and sub-basal band when viewed from above, beneath rufous chestnut basally, black mesially with the apical part broadly white, anal region chestnut, undersurface pure white.

Dimensions.—External measurements, taken in the flesh : head and body, 170 (195)[3] ; tail, 161 (172) ; hindfoot, 35 (46)[4] ; ear, 20 (18) mm.

Skull.—Total length, 43·2 (48) ; condylo-basilar length, 37·8 (44·2) ; diastema, 10·4 (11·6) ; length of upper molar series including *pm.*, 8·4 (9·5) ; zygomatic breadth, 24·5 (26·7) ; median length of nasals, 14·0.

Specimens examined.—Five skins and skulls, four from the type locality and one from an unknown locality.

Remarks.—In default of authenticated specimens from Madras, we have taken modern skins from Kanara as typical of *F. t. tristriatus*, Waterh. though it is by no means impossible that these will prove to represent yet another form.[5] The present race will probably prove to be confined to the forest country west of the Ghats in Travancore being the analogue of *F. palmarum comorinus.* The differences in size have already been noted by Wroughton (*Journ. Nat. Hist. Soc. Bombay*, XVI, p. 411 ; 1905).

8496-9. 2♂, 2♀ Sasthancotta, west side of Western Ghats, Travancore, November 1908 (Dr. N. Annandale) [C.] ; skins and skulls.
No. 8498 type of the subspecies.
9527. No particulars (Dr. Day) ; skin and skull.

Funambulus wroughtoni, Ryley.

Journ. Nat. Hist. Soc. Bombay, XXII, p. 437 (1913).

Typical locality.—Makut, South Coorg.

Type.—In British Museum.

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[1] It is this form apparently that Wroughton (*Journ. Nat. Hist. Soc. Bombay*, XXIV, p. 645 ; 1916) regards as typical *F. tristriatus*.

[2] Ryley, *Journ. Nat. Hist. Soc. Bombay*, XXII, p. 437 (1913).

[3] Measurements in parentheses those of the type of *Funambulus wroughtoni*.

[4] 40 mm. measured dry.

[5] *F. t. numarius*, antea.

Funambulus layardi.

a. **layardi layardi** (Blyth).

Journ. Asiat. Soc. Bengal, XVIII, p. 602 (1849).

Typical locality.—Ambegamoa Hills, Ceylon.
Type.—In Indian Museum, Calcutta.

9481. Ambegamoa Hills, Ceylon (E. L. Layard) [C.]; type of the species; skin and skull.

b. **layardi dravidianus,** Robinson.

Rec. Ind. Mus. XIII, p. 42 (1917).

Type of the subspecies.—Immature skin and skull. Indian Museum No. 9773, collected by Dr. N. Annandale on the western side of the Western Ghats, Travancore.

Diagnosis.—Differs from the type in having the top of the head and cheeks rich rufous orange and the undersurface yellowish-orange instead of dull chestnut. Area between the light bands on the back deep lustrous black.

Skull.—The specimen is quite immature with the deciduous premolars in place and is much damaged so it is useless giving any measurements.

Remarks.—It is unfortunate that there is no original lable attached to this specimen and that there are therefore no measurements to be quoted. It, however, serves to confirm Jerdon's statement that the species is found in Southern India and I have therefore ventured to name it. It is to be hoped that further specimens may shortly be available.

9773 imm. West side of Western Ghats, Travancore (Dr. N. Annandale) [C.]; type of the subspecies; skin and imperfect skull.

Funambulus sublineatus.

a. **sublineatus sublineatus** (Waterhouse).

P. Z. S., 1838, p. 19.

Typical locality.—Unknown. Nilgiris by subsequent designation.[1]
Type.—Originally in Zool. Soc. Coll.

7242. Panmudi, Travancore, December 1890 (H. S. Ferguson) [C.]; skin and skull.
9661 (A. S. B. 342a). Nilgiris, 1844 (T. C. Jerdon) [C.]; skin and skull.
9662 (A. S. B. 342b). Malabar, 1859 (Revd. H. Baker, junr.) [C.]; skin and skull.

b. **sublineatus obscurus** (Pelz. and Kohl.).

Verh. Zool. Bot. Ges. Wien., XXXV, p. 525 (1886).

Typical locality.—Uplands of Ceylon.
Type.—In Vienna Museum.

9663 (A. S. B. 342c). Ceylon, 1859 (Dr. Kelaart); skin and skull.

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[1] Blyth, *Journ. Asiat. Soc. Bengal*, XVI, p. 875.

The Ceylon race of this squirrel to which the above name must probably be ascribed appears to differ from the Southern Indian form in having the general colour darker and the back stripes much less distinct.

The specimen listed may be regarded as the type of *Sciurus trilineatus*, Kelaart (*Prodr. Faun. Zeylon*, p. 52 ; 1854), a name which had been inadvertently used by Blyth in speaking of *F. layardi*, thus rendering it inavailable. Under these circumstances the form has been re-named by Thomas *Funambulus kathleenae* (*Journ. Nat. Hist. Soc. Bombay*, XXIV, p. 38; 1915), which in its turn is preoccupied by the name at the head of this section.

Subfamily *NANNOSCIURINAE*.

Genus **NANNOSCIURUS**, Trouessart, 1880.

Le Naturaliste, 1880, p. 290.

Nannosciurus exilis.

a. **exilis exilis** (Mueller and Schlegel).

Tids. Natur. Ges., 1838, p. 148.

Typical locality.—Batang Singalang, Sumatra.
Type.—In Leyden Museum.

b. **exilis retectus,** Thomas.

Ann. Mag. Nat. Hist., (8), V, p. 387 (1910).

Typical locality.—Banguey Island, North Borneo.
Type.—In British Museum.

c. **exilis concinnus,** Thomas.

Ann. Mag. Nat. Hist., (6), II, p. 407 (1888).

Typical locality.—Basilan Island, Sulu Group.
Type.—In British Museum.

Nannosciurus whiteheadi (Thomas).

Ann. Mag. Nat. Hist., (5), XX, p. 127 (1887).
P. Z. S., 1889, pl. xxiv.

Typical locality.—Mount Kinabalu, North Borneo.
Type.—In British Museum.

7234. Kinabalu, North Borneo (J. Whitehead) [C.]; skin and skull.

Nannosciurus melanotis.

a. **melanotis melanotis,** Mueller and Schlegel.

Temminck's *Verhandelingen, Zoologie*, p. 98, pl. xiv, fig. 4 (1830-44).

Typical locality.—Java.
Type.—In Leyden Museum.

b. **melanotis sumatranus,** Lyon.

Proc. Biol. Soc. Washington, XIX, p. 53 (1906).

Typical locality.—Tarussan Bay, West Sumatra.
Type.—In United States National Museum.

c. **melanotis pulcher,** Lyon.

Op. cit. supra, p. 53.

Typical locality.—Singkep Island, near Sumatra.
Type.—In United States National Museum.

d. **melanotis bancanus,** Lyon.

Op. cit. supra, p. 55.

Typical locality.—Klabat Bay, Bangka Island.
Type.—In United States National Museum.

e. **melanotis borneanus,** Lyon.

Op. cit. supra, p. 54.

Typical locality.—Sanggau, West Borneo.
Type.—In United States National Museum.

9460. Sarawak, Borneo (A. R. Wallace) [C.]; skin and skull.

ADDENDA.

p. 173. **Petaurista yunnanensis** (Anderson).

10335. Nam Tamai Valley, Putao, N.-E. Burma, 4,500 ft., 27° 50′ N., 97° 50′ E., 29th June 1918; skull and rostrum.

Though this specimen is not quite typical it is best referred to this species until better specimens are obtained. It is more profusely speckled with white above than the original typical series and the general colour is a less deep maroon.

p. 174. **Petaurista lylei,** Bonh.

b. **lylei venningi,** Thos.

10339. Kalaw, Southern Shan States (G. Lee Tuppen) [C]: skin and skull.

Agrees fairly well with the original description, being a generally darker animal than the typical *P. l. lylei* from Siam with four specimens of which it has been compared.

p. 192. **Ratufa gigantea.**

a. **gigantea gigantea** (McClell.)

10336-7. Putao Road (Hkamti Long), N.-E. Burma, Lat. 27° 30′ N; 26th June 1918 (Dr. Murray Stuart) [C]; skins only (remade).

These specimens appear to be referable to *R. gigantea gigantea* (McClell.), which has also been obtained at Hkamti on the Upper

Chindwin (*Jour. Nat. Hist. Soc. Bombay*, XXIV, p. 226) and is known from N. Siam and the N. Shan States.

No. 10366 has an obscurely speckled appearance due to narrow hazel terminal annulations.

p. 198. **Callosciurus erythraeus** (Pallas).

g. **erythraeus gordoni** (Anderson).

10334. Nam Tisang Valley, Putao (Hkamti Long), N.-E. Burma, 2,000 ft., Lat. 27° 30′ N., April 1918 (Dr. Murray Stuart) [♂]; skin.

INDEX TO LIST OF ORIENTAL SCIURIDAE.

The entries are arranged under the names of genera, of species and of subspecies.

XXII. REVISION OF THE ORIENTAL TIPULIDAE WITH DESCRIPTIONS OF NEW SPECIES.

PART II.

By E. Brunetti.

(With Plates VII, VIII.)

Late in 1911 I published a revision of the Oriental Tipulidae, listing all the species known at that date, with notes that appeared of interest and descriptions of over fifty new species. Since then my volume including this family in the "*Fauna of British India*" series has been published, containing descriptions of considerably over one hundred and twenty new species; whilst papers by de Meijere, Alexander, Enderlein and others of recent date have appeared, containing further descriptions and many synonymic notes of importance. In the present paper it is my endeavour to record all species set up since my first paper, to incorporate all corrections and to describe over seventy new species. Mere records of localities are not included as they will figure in my forthcoming catalogue of Oriental Nemocera, but the species taken recently by Dr. Annandale in Japan and Siam are mentioned.

Special appreciation is due to Mr. S. Kemp for his collecting of a very large number of Tipulidae from Goa in Portuguese India, the Garo Hills, Assam and elsewhere, including a considerable number of new species, all the specimens being in exceptionally good condition and perfectly pinned. In this work also Mrs. Kemp deserves special mention for her energetic collaboration.

Unless otherwise stated, the types of all the new species are in the Indian Museum collection.

The total number of species in this family now known from the Oriental and South Asiatic Region, as far as I can ascertain, is nearly six hundred.

Subfamily PTYCHOPTERINAE.

TANYDERUS, Phil.

To the only previously known oriental species (*ornatissimus*, Dol.) de Meijere has added a second, *mirabilis*, (Tijd. v. Ent. LVIII, 104, fig. 1, wing, 1915) from Papua. The (presumably) 3rd submarginal cell is not bisected at the middle by a crossvein as it is in the genotype *pictus*, Phil. from Chili. The only remaining known species is *forcipatus*, Os. Sac. from New Zealand.

PTYCHOPTERA, Mg.

A ♂ of what is possibly an undescribed species was taken by Dr. Annandale at Otsu, near Kyoto, Japan, x-15.

Ptychoptera tibialis, Brun.

P. atritarsis, Brun., *Rec. Ind. Mus.*, VI, p. 234 ♀ (1911).

My *atritarsis* is only the ♀ of *tibialis.* I took a long series of this species at Darjiling in June, 1917 and it shows some variation in the coloration of the legs. In the ♂ the anterior tibiae are mainly black, the apical half of the middle pair being more or less yellowish ; in the ♀ the anterior tibiae are wholly yellow, at most the basal part of the middle pair a little blackish. As regards the hind femora in the ♀, all grades are present from a distinct black basal half to wholly orange yellow. The antennae are certainly only 15-jointed but the last joint, though attenuated, is only from slightly longer than to one and a half times as long as the penultimate, and not twice as long as stated in my description.

Ptychoptera annandalei, sp. nov.

♂. Southern Shan States. Long. 6 mm.

Head and palpi pale brownish-yellow ; frons, vertex and upper part of occiput brilliantly shining dark blue ; antennae about as long as abdomen ; scape bright yellow, about basal half of first flagellar joint yellowish, rest of antennae black with microscopic greyish pubescence and a few longer hairs.

Thorax.—Dorsum brilliantly shining dark blue, the colour extending posteriorly over the whole of the metanotum except for a large oblong yellow spot in the centre, the blue colour everywhere very sharply delineated from the pale yellow sides of the thorax and the very small bright yellow scutellum.

Abdomen brownish-yellow, hind margins of segments with more or less narrow black bands, broadest on last segment, very narrow on penultimate segment. Genitalia large, conspicuous and complex, consisting apparently of two pairs of large claspers, the second joint of the upper pair provided on the upper side with a comb-like organ of stiff black bristles. A small ventral plate, produced into two long style-like hairy fingers, curved upwards and ending in sharp points.

Legs yellowish, femora and tibiae narrowly black towards tips ; tarsi black.

Wings pale grey, costal cell yellowish ; two narrow pale blackish transverse bands of varying intensity (as in the second specimen they are much paler) ; the first across the middle of the wing, over the " cross veins," the second from the rather small black oval stigma, across the bases of the " forked cells." Halteres black, extreme base of stems yellowish.

Described from two ♂ ♂ in the Indian Museum from Kalaw, 4,000—4,500 ft., Southern Shan States, Burma 10-iii-1917 (*Gravely*). Not uncommon at the roots of grass at dusk, but difficult to capture.

Subfamily TIPULINAE.

Section *CTENOPHORINI.*

Xiphura indica, sp. nov.

(Plate viii, fig. 1.)

♂. Darjiling. Long. 12 mm.

Head blackish-grey with yellowish hairs, more or less white dusted on frons, face, and lower part of head ; a well defined yellow circle on frons around base of each antenna ; scape of latter black, tips of both joints yellowish, 1st flagellar joint of same length as the rest, with two thumb-like prolongations on under side ; 2nd to 12th joints with a bisinuate ray on inner and outer sides, placed at base of each joint, and a thumb-like prolongation on under side of each at about the middle ; 13th joint without rays, slightly longer than 12th, with a slight thickening in middle of under side. Each ray has a single verticil on upper side at about one-third of its length and each joint one on upper side in middle ; in addition, each ray is microscopically pubescent. Proboscis blackish-brown, pubescent, bright yellow for a short space on each side near base : palpi blackish brown ; occiput black.

Thorax bright shining yellow ; collare conspicuous. Three coalescent shining black spots in middle of dorsum, taking the form of a median broad band with parallel sides, not reaching anterior margin, and two oval contiguous spots on each side barely interrupted by suture, practically forming one spot on each side of the short median stripe. Scutellum and metanotum yellow ; latter with two round blackish spots on hinder side.

Abdomen shining yellowish ; a more or less distinct median shining black stripe, and hind borders of segments black, the colour spreading over greater part of apical half of abdomen. Genitalia large, black.

Legs shining black or (tibiae) blackish brown ; under side of femora yellowish except at tips ; basal half of fore femora, which are distinctly thickened towards tips, shining yellowish brown.

Wings distinctly yellowish, shining, iridescent ; stigma brown ; most of the veins slightly grey suffused, also wing tip ; halteres yellow, clubs dark brown.

Described from a single perfect ♂ in my own collection, taken by me at Darjiling, 6,900 ft., i-vi-1917. The first species of this genus known from the East.

PSELLIOPHORA, Os. Sac.

Pselliophora laeta, F.

A ♂ from Castle Rock, North Kanara District, differs from the typical form by the head, thorax and femora being wholly black. The two large spots on the wing are paler yellow and do not quite reach the costa, whilst the basal pale spot (normally united more or less to the proximal large spot narrowly along the costa) is absent.

Pselliophora gaudens, Walk.

A ♀ in the Indian Museum, from Singla, Darjiling District, 1,500 ft. (Lord Carmichael's coll.) June, 1913 is probably this species, as the only discrepancies are the absence of any yellow at the base of the dark brown wings, and the colour of the transverse band on the wings, which is yellow, not whitish. Described from Celebes, from whence other specimens are known, but the species is not recorded from elsewhere than that island.

Pseliiophora fumiplena, Walk.

Mr. Edwards notes some specimens of this in the British Museum from " North China." This species is possibly out of place in Oriental lists.

Pselliophora divisa, Brun.

A ♀ from Pashok Spur, Darjiling District (*R. S. Lister*) in the Indian Museum agrees exactly with my description. The type is in the Vienna Museum labelled " East Indies." Edwards records (*Ann. Mag. Nat. Hist.* (8) XVIII, p. 254) a ♂ in the British Museum from Sikkim, 2,000 ft., May 1896, and a ♀ from Bhutan, adding some interesting sexual notes.

Pselliphora elongata, Edw.

Ann. Mag. Nat. Hist. (8) xii, p. 202 ♀ (1913).

From Hakgala, Ceylon, 4,500 ft., v-1911. The unique type in the British Museum.

Pselliophora suspirans, Os. Sac.

Bezzi describes a new variety of this, *hilaris*, from three localities in Luzon (*Phil. Jour. Sci.* XII, Sect. D, p. 109 ♂ ♀ (1917).

ctenophorina, Riedel, *Ent. Mitt.* II, p. 274 (1913).

Kankau (Koshun), Formosa, v, vi, vii, ix, 1912. Edwards records a ♂ in the British Museum from Koannania, S. Formosa, 15-vi-06 (*Wileman*). Types and cotypes in Deuts. Ent. Mus. ; cotypes in Riedel collection.

strigipennis, de Meij., *Tijd. v. Ent.* LVI, Supp. p. 5 ♀ 1913 (Mar. 1914). Java.

speciosa, Edwards, *Ann. Mag. Nat. Hist.* (8) XVIII, p. 254 ♂ (1916). Khasi Hills, Assam. Unique type in British Museum.

semirufa, *id., loc. cit.*, p. 255 ♀ (1916). Taihoku, xi-1909 (*Nitobe*). Unique type in British Museum.

luctuosa, de Meij., *Tijd. v. Ent.* LIX, p. 199 ♀ (1916). Gunnung Susuruh, Preanger, Java (*Corporaal*).

praefica, Bezzi, *Phil. Jour. Sci.*, XII, Sect. D, p. 110 ♂. Mindanao, Phil. Is. (*Baker*).

tripudians, *id., loc. cit.*, p. 111 ♀ (=?*praefica* ♀). Laguna, Phil. Is. (*Baker*).

Pselliophora approximata, sp. nov.

♀. S. W. India. Long. 12½ mm.

Head and *thorax* wholly and uniformly bright orange; dorsum of antennae just perceptibly darker; palpi slightly duller.

Abdomen brownish-orange, last segment and genitalia shining black.

Legs.—Coxae and femora orange, latter with moderately broad apical ring; rest of legs black; hind tibiae with yellowish ring at base, a bare trace of similar rings on anterior tibiae.

Wings blackish: both basal cells, basal half of costal cell, marginal cell (the colour extending to the costa), basal parts of discal, 4th and 5th posterior cells, and basal half of anal and of both axillary cells bright orange yellow. Halteres orange.

Described from a single ♀ in the Indian Museum. Talewadi, near Castle Rock, N. Kanara District, 3—10-x-16 (*Kemp*).

This must be very like *gaudens*, Walk. described from Celebes, but that species presumably has a white basal ring on all the tibiae and the blackish wings have a " whitish " exterior band which is attenuated hindward. It is also distinctly larger, 7 to 10, lines. The black and yellow colours in the wing are so evenly divided that it is impossible to correctly assign it to either my group B or BB in the table of species given in my previous paper on this family. Assuming the wing to be " principally black " it will separate from *gaudens*, Walk. on the characters given above.

Pselliophora flavofasciata, sp. nov.

(Plate viii, figs. 2, 3.)

♂ ♀. Assam. Long. ♂ 10 mm.; ♀ 12 mm. to tip of ovipositor.

Head.—Occiput much flattened, upper half shining dark brown; antennae placed practically on vertex, black, except 1st scapal joint pale yellow; rest of head mainly moderately dark brown; yellowish below antennae and rather bright pale yellow on lower half of back of head; nasus and palpi with black hairs.

Thorax.—Dorsum very shining dark brown, just perceptibly lighter at ends of suture: collare conspicuously bright orange; pleurae pale yellowish, nearly white; sternopleura and pteropleura dull black; scutellum dull yellow; metanotum dark shining brown.

Abdomen.—1st and 2nd segments bright chrome yellow; apical half of 1st and nearly apical half of 2nd black; 3rd, 4th and 5th bright chrome yellow with a black stripe at middle of both sides, extending upwards from the all black belly (these stripes much shorter in ♂); rest of abdomen black, hind margin of 6th segment yellowish. Genitalia in ♂ black, the large basal joint of claspers shining yellowish-brown; in ♀ ovipositor shining mahogany brown. Belly of 1st and 2nd segments as upper side, rest black, hind margins narrowly yellow.

Legs very dark brown; a broad white ring at base of all tibiae.

Wings dark blackish-brown, shining; a pale yellow stripe including basal half of marginal cell, nearly apical half of 2nd basal cell and all

the 5th posterior cell, except that the posterior cross vein is rather broadly brown suffused. Basal third of anal and 1st axillary cells nearly clear. Halteres blackish, tips of clubs whitish.

Described from 2 ♂♂ and 2 ♀♀ from above Tura, Garo Hills, Assam, 3,500—3,900 ft., vii-17 (*Kemp*).

Pselliophora aurantia, sp. nov.

♀. Assam. Long. 12½ mm. to tip of ovipositor.

Head bright orange yellow; nasus with concolorous rather long hair: antennal scape dark brown; flagellum black; palpi with 1st and 2nd joints yellowish or brownish yellow; rest dark brown.

Thorax, scutellum and metanotum orange yellow; pleurae lemon yellow; pteropleura more orange yellowish.

Abdomen orange yellow; a median black stripe on basal half of 2nd segment, and a black transverse band beyond middle; a similar band on base of 3rd segment, both more or less indefinite, evidently variable; tip of abdomen dark brown, extent of colour evidently variable; ovipositor shining dark brown. Belly orange yellow except the blackish tip.

Legs.—Femora orange yellow except extreme tips of anterior pair and a sub-apical black ring on hind pair; tibiae dirty brownish yellow with a distinct though not conspicuous narrow white ring just beyond base on all three pairs, broadest on hind pair; tarsi black.

Wings yellowish-grey, shining, iridescent; stigma small, dark brown, clear cut; halteres yellow, inner side of clubs blackish.

Described from two ♀♀ in Indian Museum from above Tura, 3,500—3,900 ft., viii-17 (*Kemp*).

Pselliophora latifascipennis, sp. nov.

♀. South India. Long. 20 mm. to tip of ovipositor.

Head.—Occiput and frons dark blackish-grey with stiff hairs round sides; face brown, nasus brownish yellow, hairy, with short golden hairs on upper side; labella large, brownish-yellow, hairy. Palpi blackish brown, hairy, 2nd joint smooth, pale, with fine hairs; 4th joint with a knotted appearance. Antennae wholly black.

Thorax barely shining, dark olive green, nearly blackish; dorsum with almost microscopic sparse yellow hairs in places. Marginal space between dorsum and underside yellowish-brown, the colour extending narrowly between the prothorax and mesothorax and carried downwards in front of the sternopleura. Mesonotum black.

Abdomen practically bare, 1st segment wholly, nearly the apical half of 2nd, 3rd except hind margin, 5th except at sides, 6th, 7th and 8th wholly black, the remainder of the abdomen orange yellow. Belly much the same as upper side. Ovipositor black, valves shining reddish-brown.

Legs (middle pair missing).—Coxae dark olive brown, fore pair yellowish brown in front: femora brownish-yellow, fore pair black on nearly apical half, hind pair with broad black apical ring. Tibiae and

tarsi all black, a sub-basal narrow white ring on former. Legs microscopically pubescent.

Wings almost equally divided into yellow and black. They can be best described as yellowish with the tip broadly blackish brown from costa to hind margin, the colour filling the 2nd submarginal, 1st, 2nd and 3rd posterior cells and encroaching on about half of the discal cell and a little way into the 4th posterior cell. A broad median blackish-brown band from the costa (where it is fainter) extending across the wing to the hind margin, where it runs along the margin narrowly to the base of the wing, extending also along some part of the 7th longitudinal vein. Its breadth is approximately uniform and covers about the middle third of the basal cells. No stigma; halteres blackish.

Described from a unique ♀ from Pollibetta, Coorg South India, 24-x—16-xi-15 (*Fletcher*). *Type* presented by Mr. T. B. Fletcher to the British Museum.

Section *TIPULINI.*

PRIONOCERA, Loew.

Stett. Ent. Zeit. V, p. 170 (1844).
Prionota, Wulp, *Notes Leyd. Mus.* VII, p. 1 (1885).
Stygeropis, Loew, *Berl. Ent. Zeits.* VII, p. 298 (1863).

One new species, *P. flaviceps,* Ender. (*Zool. Jahr.* XXXII, p. 28; 1912). The unique ♀ type from Sumatra in Stettin Zoological Museum.

CTENACROSCELIS, Ender.

Zool. Jahr. XXXII, p. 1 (1912).

Genotype: *C. dohrnianus,* Ender., by original designation.

Enderlein describes three new species on which he founds this genus, *dohrnianus* (*loc. cit.,* p. 1, ♀ fig. A, wing, from Sumatra); *sikkimensis* (*l. c.,* p. 4, ♂, from Darjiling; and *sumatranus* (*l. c.,* p. 5, ♀, from Sumatra). The three unique types in Stettin Zoological Museum.

He also removes *Tipula praepotens,* Wied. here. The genus is characterised by a row of black spines on the upper side of all the femora towards the tip. Alexander regarded the genus as synonymous with *Holorusia,* Loew.; in his subsequent paper on Javan Tipulidae he recognised it as valid, but he compares the characters of the two genera and with those of *Tipula.*

At the moment of going to press I receive information (through the kindness of Mr. T. Bainbrigge Fletcher) of the following gigantic new species described by Alexander.

rex, Alex., *Insec. Insit. Menst.* V, p. 21, ♂ (1917).

Two ♂ ♂ from Taungoo District, Burma. Type in American Entomological collection, Philadelphia; cotype in Alexander's collection. He claims it to be possibly the largest species of the family in the world, each wing measuring 40 mm., but the full expanse of my *Tipula carmichaeli* is 91 mm. and is also a ♂. There cannot, therefore, be much difference between them and the females of both are probably larger.

TIPULA, L.

One species, *praepotens*, W. has been removed to his new genus *Ctenacroscelis* by Enderlein.

The following new species have been described by Dr. de Meijere: *T. cinctipes, Tijd. v. Ent.* (1911) LIV, p. 64 ♂, Borneo; *gedehana, l. c.*, p. 66, ♀, pl. iv, 47, wing, Java; *cinereifrons, l. c.*, p. 68, ♂, pl. iv, 48, wing, Java[1]; *inconspicua, l. c.*, p. 70, ♂, pl. iv, 49, wing, Java. Types of first three species in Leyden Museum; the unique type of *inconspicua* in Amsterdam Museum.

He also removes to *Tipula* his *Tanypremna omissinervis.*

In my Fauna volume (1912) the following new species are described. *T. gracillima*, p. 302 ♀, Ceylon; *princeps*, p. 306 ♂ ♀, Kurseong; *dives*, p. 307 ♂, Kurseong; *serricornis*, p. 309 ♂ ♀, Naini Tal; *pulcherrima*, p. 310 ♂ ♀, E. and W. Himalayas; *fuscinervis*, p. 312 ♀, Kurseong; *patricia*, p. 313 ♀, Kurseong; *splendens*, p. 314 ♂, Gahrwal District; *tessellatipennis*, p. 317 ♂ ♀, Naini Tal; *marmoratipennis*, p. 319 ♂, Darjiling; *quasimarmoratipennis*, p. 320 ♀, Darjiling, Kurseong; *griseipennis*, p. 321 ♂, pl. v, 15, wing; *nigrotibialis*, p. 324 ♂, Darjiling; *striatipennis*, p. 325 ♀, Kurseong; *subtincta*, p. 326 ♂, Kurseong; *continuata*, p. 328 ♂ ♀, Darjiling; *quadrinotata*, p. 330 ♀, Manipur; *brunnicosta*, p. 332 ♂ ♀, Simla; *tenuipes*, p. 333 ♀, Sylhet; *flavescens*, p. 334 ♀, Ceylon; *munda*, p. 336 ♂ ♀, Mussoorie; *cinctoterminalis*, p. 338 ♀, Kurseong; *elegantula*,[2] p. 339 ♂, Assam. The types of all these species, many represented by unique specimens only, are in the Indian Museum.

Tipula marmoratipennis, Brun.

One ♀, Darjiling, 7,000 ft., 10-vi-17 (*Brunetti*).

Tipula quasimarmoratipennis, Brun.

Five ♂ ♂ and a ♀, all in splendid condition, from above Tura, Garo Hills, Assam, 3,500—3,900 ft., ix-17 (*Mrs. Kemp*), in conjunction with the three ♀ ♀ in the Indian Museum fix this species definitely as quite valid, as are also my *marmoratipennis*, *griseipennis* and *tessellatipennis*, all of which are represented by further specimens of each since their description. Though so closely allied the small distinctions appear quite constant.

T. himalayensis varies most in this group but is easily recognised by the yellow subapical femoral ring which is absent in all the others with marmorated wings except *elegans*, of which I have seen no specimen except the original type.

Tipula gracillima, Brun.

Described from a single ♀ from Peradeniya, a second ♀ coming from Cochin State. Four ♂ ♂ from Castle Rock, N. Canara District, taken

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[1] Enderlein records it from Sumatra.

[2] The figure of a wing attributed to *elegantula* in the Fauna volume is not this species, nor am I able to say what species it does represent.

by Mr. Kemp are apparently of the same species. The median dorsal stripe on the thorax has a very fine line on each side of it, and each of the usual outer stripes is replaced by a pair of narrower stripes. The abdominal markings are more distinct, especially the apical black band and basal whitish one; the genitalia are of considerable size, and the 2nd tarsal joint is broadly black instead of wholly snow white as in the ♀.

Tipula fulvolateralis, Brun.

Alexander thinks this is probably synonymous with *T. umbrinus*, W., but as he puts this species in *Ctenacroscelis*, Ender., a genus characterized by spines on the femora, they cannot be identical as there are certainly no femoral spines in my species. It is the commonest of the very large species in the Himalayas.

Tipula borneensis, nom. nov.

Tipula pallida, Walk., (1865).

The specific name *pallida* being preoccupied by Loew in 1863 for a North American species, the name *borneensis* is herewith proposed for Walker's species.

Tipula melanomera, Walk.

One ♂ of what is probably this species from Sureil, Darjiling District, 5,000 ft., iv-v-17 (*Kemp*). The thorax is uniformly orange. The species was described from Sikkim. An extraordinary resemblance exists between this species and my new one *Pachyrhina hypocrites* taken in the same locality.

coquilletti, Ender., *Zool. Jahr.* XXXII, p. 7 (1912). *Nom. nov.* for *nubifera*, Coq. 1898 preocc. Wulp. 1881. Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*). Also occurs in Japan.

carmichaeli, Brun., *Rec. Ind. Mus.* IX, p. 257, ♂ (1913). A unique specimen captured by Lord Carmichael at Sureil, Darjiling District, June 1913. Type in Indian Museum.

imperfecta, *id., loc. cit.*, p. 260, ♀ (1913). Unique type from Darjiling in Indian Museum.

tropica, de Meij., *Nova Guin. Res.* IX, p. 311, ♀ (1913).

novae guineae, *id., loc. cit.*, p. 313, ♂ ♀ (1913).

divergens, *id., loc. cit.*, p. 312, ♂ ♀ (1913).

dentata, *id., loc. cit.*, p. 313, ♂ ♀ (1913).

The above four species from Papua, the types in Amsterdam Museum.

aetherea, de Meij., *Tijd. v. Ent.* LVIII, Supp., p. 7, 1915, ♀ (Mar. 1, 1916).

sinabangensis, *id., loc. cit.*, p. 9, ♂ ♀ (Mar. 1, 1916).

pumila, *id., loc. cit.*, p. 9, ♂ (Mar. 1, 1916).

The above three species from Simalur Island, near Sumatra; the types (presumably) in Amsterdam Museum.

klossi, Edw., *Ann. Mag. Nat. Hist.* (8) XVII, p. 351, ♀ (1915). Kedah Peak, 3,200 ft., Malay Peninsula (*Dr. Stanton*).

Type in British Museum, paratype in Kuala Lumpur Museum.

shirakii, Edw., *loc. cit.*, XVIII, p. 258, ♀ (1916). Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*). Khasi Hills, Assam. The latter specimen in the British Museum, the type is not.

rufomedia, *id.*, *loc. cit.*, p. 259, ♂ ♀, pl. xii, 5-7, genitalia (1916). Horisha, Formosa (*Maki*); Formosa (a second specimen). Types in British Museum.

Tipula gravelyi, sp. nov.

♂. Darjiling. Long. about 32 mm. from tip of nasus to tip of genitalia.

Head very dark velvet brown, nearly black; nasus dark brown; antennae black, seen to be grey dusted in certain lights; verticillate hairs pale yellowish; 2nd basal joint reddish-brown: palpi brown, tips black, a little pale at base of each joint.

Thorax dark velvet brown, a little darker towards sides of dorsum. Pleurae less dark than dorsum, whitish dusted on sternopleura, pteropleura and hypopleura. Scutellum dark brown; with a little silvery shimmer, which extends forwards between the post sutural callosities and along the suture itself each side for a short distance; also along the frenulum and over part of the posterior calli. Metapleura well defined, brownish yellow. Some soft, moderately short dark pubescence along sides of dorsum and a few fine pale hairs on hind margin of scutellum.

Abdomen moderately pale brown, last segment darker; 1st segment at base with a little whitish shimmer, remaining segments with a pale brownish yellow transverse streak,—interrupted in the middle,—towards base, except on 2nd segment, in which it lies approximately across the middle. Extreme sides of dorsal plates narrowly black, the hind angles pale, as are also the extreme margins of 5th and 6th segments. (Possibly in individuals margins of other segments also pale.) A few very short pale yellowish hairs at sides of segments and along hind margins. Genitalia very large and conspicuous, shining dark brown. A very large curved dorsal plate, with a little golden yellow pubescence towards sides and tip; a pair of claspers with the usual large basal joint, the 2nd joint being long, irregularly conical, slightly curved, horny, shining bright brown, with long bright yellow hairs on outer side. A large lower piece is present, and apparently some inner organs; the ventral plate is very small, subquadrate.

Legs brownish-yellow, coxae and tarsi tips darker; a practically apical yellow ring on femora with a narrow black ring immediately preceding it. Extreme base of tibiae just perceptibly paler yellowish.

Wings dark grey; costal, stigmatic and discal cell regions distinctly yellow. Costa slightly bulging out in front of the stigma, which, with a short distance around it, is very dark brown, as is also a spot over base of 2nd longitudinal vein. A small pale yellow spot occurs towards tip of 2nd submarginal cell, and in the centre of the margin of all five posterior cells. A similar spot on wing margin immediately behind 6th vein, a small one in front of 7th vein. In the 1st basal cell a pale yellowish space just before origin of 2nd vein; in 2nd basal cell a similar spot like a "7" backwards, continuing into anal cell. A very small pale

yellowish spot just beyond middle in 1st posterior cell; another near base of 4th posterior cell; another just beyond base of anal cell; another a little further on in 1st axillary cell. Base of 1st and in a less degree the 2nd basal cell darker brown. Halteres brownish-yellow with dark brown knobs.

Described from a unique ♂ in the Indian Museum. Darjiling, 7,000 ft., 13-vi-14, in perfect condition (*Gravely*).

Tipula contigua, sp. nov.

♂. Assam. Long. 13 mm.

Head.—Occiput and frons blackish-grey, rest of head brownish-yellow with whitish reflections; proboscis, labella and palpi moderately dark brown, latter with last joint yellow. Antennae with 1st scapal joint yellow, 2nd brown, flagellum black.

Thorax light grey with three blackish longitudinal stripes, the outer ones very much foreshortened; dorsum behind suture, also scutellum and metanotum blackish. Pleurae pale brownish-yellow with whitish reflections.

Abdomen yellowish-brown; segments narrowly blackish towards hind margins but extreme margins pale; last two or three segments mainly blackish. Genitalia of moderate size, brown, apparently normal.

Legs.—Femora dirty brownish-yellow, hind pair darker. Anterior tibiae blackish-brown, a little lighter towards tips with a snow white ring just beyond middle; hind pair black, with a broad sub-basal white ring and a very broad one just beyond middle. Fore tarsi brownish-yellow, middle pair dark brown, hind pair snow white except basal fifth of metatarsus.

Wings pale grey; stigma distinct, black, the colour extending over base of 2nd submarginal cell and 1st posterior cell; basal side of discal cell, posterior cross vein and apical section of 5th vein blackish suffused. Apical half of both submarginal cells pale smoky black, the colour extending indistinctly and indefinitely along wing border. Halteres black.

Described from a single ♂ in the Indian Museum from above Tura, Garo Hills, Assam, 3,500—3,900 ft., viii-17 (*Kemp*).

This species bears a general resemblance to my *patricia* but the yellowish and brown fore and middle tarsi respectively easily separate the species from all others in this group.

Tipula simillima, sp. nov.

♂. West India. Long. 12-13 mm.

Differs from my *gracillima* only in three minor characters but which appear to be constant. The stigma fills only the apical half of the marginal cell instead of all of it; the femoral rings are twice as broad as in *gracillima* and rather more yellowish; but the principal character is that the 2nd joint of the tarsi is broadly black on the anterior pairs and more narrowly so on the hind pair, whilst in *gracillima* the tarsi are all white except the base of the metatarsus.

Three ♂ ♂ in the Indian Museum, taken by Mr. Kemp at Castle Rock, N. Kanara District, 11—26-x-16.

Tipula fumifascipennis, sp. nov.

♂ ♀. Darjiling. Long. ♂ 17, ♀ 25 mm. excl. ovipositor.

Head.—Frons and occiput mouse grey, latter with numerous short black hairs; rest of head, proboscis and labella brownish-yellow, latter dark brown above; palpi dark brown, pale at emarginations, last joint black. Antennae brownish-yellow, flagellar joints, except 1st, more or less blackish at base.

Thorax brownish-yellow, prothorax a little darker, dorsum light brownish-grey; configuration of the usual three stripes slightly darker. Scutellum darker brown; metanotum pale yellowish, with grey dorsum. Pleurae paler brownish-yellow.

Abdomen in ♂ mainly yellowish, two basal segments principally brownish-yellow above, hinder part of 1st segment obscured. Who e upper surface of abdomen with very short yellow hairs except at emarginations. In the ♀ darker grey, actual sides with a distinct black stripe from base and tip. Dorsum of 1st segment mainly yellowish. Belly grey in ♂ and ♀.

Legs.—Coxae brownish-yellow: femora brownish-yellow at base, gradually darkening to dark brown at tips where the colour appears as a broad apical black band, ill defined proximally. Tibiae and tarsi dark brownish-yellow, rather lighter in ♀.

Wings distinctly grey, darker brownish-grey from the slightly yellowish grey costa to the 4th longitudinal vein, except towards wing tip, but the brownish colour extending over apical third of 2nd basal cell except at its tip. There is also a slight brownish suffusion across the anal cell, just before the middle. A nearly clear space from inner side of the inconspicuous, barely darker brown stigma, downwards, embracing tips of both basal cells and proximal half of discal cell, below which it diffuses somewhat along bases of 2nd, 3rd, 4th and 5th posterior cells. Basal two-thirds of 2nd basal cell and basal half of anal cell (except for the brownish spot) clearer than ground colour of wing. Halteres black.

Described from a ♂ and ♀ in good condition in the Indian Museum from Darjiling, 6,000—7,000 ft. 11-vi-14, *type* ♂; 12-vi-14, type ♀ (both *Gravely*); a second ♂ from Darjiling taken by me, 7,000 ft., 28-v-10.

Tipula fumicosta, sp. nov.

♂. Assam. Long. 15 mm.

Head.—Occiput and frons dark grey; proboscis brownish-yellow, hairy; labella broadly brown margined; palpi blackish-brown, pubescent, base of 2nd and 3rd joints narrowly pale. Antennae brownish-yellow, base of each joint except 1st (and perhaps 2nd) narrowly black.

Thorax pale brownish-yellow, dorsum slightly grey, with the configuration of the three usual stripes; prothorax and neck rather darker brown. Scutellum greyish, with some bright yellow hairs on posterior margin.

Abdomen brownish-yellow, becoming brown towards tip of 2nd segment and gradually darkening to black at tip. 2nd segment in *type* with a narrow, transverse black line (interrupted in centre) across middle of segment, giving the appearance of two segments. Genitalia composed

of a thick large black square barely curved dorsal plate with scattered dark golden brown hairs and a fringe of golden ones on hind margin. 1st joint of claspers large, blackish, 2nd brownish yellow, its exact shape indeterminable ; a narrowly keeled ventral plate.

Legs brownish-yellow, tibiae sometimes darker (*type*) : femora with a moderately broad black apical ring.

Wings uniformly pale grey ; costal cell brownish yellow stigma small, inconspicuous, brownish, restricted to outer half of marginal cell. A faint darker grey spot in 2nd basal cell towards end, contiguous to 5th longitudinal vein, and a similar one before middle of anal cell. Halteres blackish.

Described from two ♂ ♂ in the Indian Museum from Shillong, 5,500 –6,400 ft. 28-viii—5-ix-15, *type* (*Kemp*) ; and Shillong, 4,900 ft., 10 —12-x-14 (*Kemp*). In the second specimen the abdomen is wholly moderately dark blackish-brown, and the tibiae no darker than the rest of the legs. A barely perceptibly paler streak runs through the 2nd basal, discal, and 2nd, 3rd and 4th posterior cells. A third ♂ comes from Tura, Garo Hills, Assam, 1,400 ft., ix-17 (*Mrs. Kemp*) and in it the faint dark spots in the 2nd basal and anal cells are absent.

Tipula flavoides, sp. nov.

♂ ♀. Assam. Long. tip of nasus to tip of genitalia, ♂ about 24, ♀ about 28 mm.

Closely allied to my *flava* and *serricornis* but certainly distinct. The first flagellar joint is narrow, as long as 1st scapal, the 2nd rather shorter, 3rd rather shorter still, all *subcylindrical,* barely deeper in middle, the remaining joints except the last one or two distinctly convex on lower sides. In *serricornis* the 1st flagellar joint is cylindrical, not quite so long as 1st scapal, but the remaining joints (except the apical joint) are *subtriangular,* the upper side nearly horizontal, all well separated. In *flava* the joints are presumably normally tipuliform (I have no specimen of it to compare). *Flavoides* has the palpi black, the flagellum similar but slightly pale at base. The abdomen is uniformly dark velvet brown on the dorsum in the ♂, less dark in ♀ and less uniformly coloured. Legs except coxae and trochanters blackish brown, very slightly pale about base of femora. The dorsal plate in the ♂ genitalia is quadrate whereas in both *flava* and *serricornis* it is distinctly bilobed.

Described from one ♂ and two ♀ ♀ from above Tura, Garo Hills, Assam, 3,500—3,900 ft., ix-17 (*Mrs. Kemp*).

Tipula filicornis, sp. nov.

♂. Darjiling. Extreme length 14 mm.

Head yellowish-grey ; proboscis more brownish ; palpi pale yellowish. Antennal scape brownish-yellow ; flagellum very long and slender, the joints much longer and narrower than usual in this genus ; rather dark brown, verticils long and numerous.

Thorax.—Dorsum not very dark brown grey ; two narrow paler median stripes anteriorly, rather close together. Under side very pale yellowish : metanotum yellowish-grey.

Abdomen yellowish-brown, blackish towards tip. Genitalia brownish-yellow, the claspers small; a moderate sized, curved dorsal plate fringed apically with bright yellow hairs;

Legs proportionately long and thin, black, coxae and base of femora a little yellowish.

Wings pale grey; stigma obvious but irregular, blackish, moderate in size.

Described from a perfect unique ♂ in the Indian Museum from Pashok, Darjiling District, 3,000 ft., 26-v—14-vi-16 (*Gravely*).

The extremely attenuated form of the antennae distinguishes this species from all others occurring in India.

Tipula rufiventris, sp. nov.

♀. Darjiling. Long. about 18 mm. from tip of nasus to tip of ovipositor.

Head, thorax and scutellum wholly deep velvet black; antennae and palpi in certain lights shewing a little grey dust; a little sparse dark pubescence towards margins of thoracic dorsum.

Abdomen.—1st segment and base of 2nd black; rest of 2nd and from the 3rd to the 7th inclusive bright brownish yellow with almost a red tinge; sides narrowly blackish from 3rd segment onwards, the black colour gradually widening; 8th segment all black. Belly black, with very fine black pubescence, 3rd, 4th and 5th segments mainly reddish or brownish-yellow, the colour extending obscurely over the centres of the next two segments. Ovipositor exhibiting only the two small black terminal lamellae.

Wings dark grey; stigma rather small, yellowish; petiole of 2nd posterior cell about one-third as long as the cell: veins brownish-black; halteres black.

Described from a type ♂, Pashok, Darjiling District, vi-16 (*L. C. Hartless*), and a type ♀ taken in long grass from Soom, Darjiling District, 3,000—3,500 ft., 15-vi-14 (*Gravely*); also from two more ♀♀ from Pashok, vi-16, and three ♂♂ and four ♀♀ from above Tura, 3,500—3,900 ft., ix-17 (*Kemp and Mrs. Kemp*).

Types in Indian Museum.

Tipula flavithorax, sp. nov.

♂. Cochin State. Long. 14 mm. from tip of nasus to tip of genitalia.

Head, proboscis and palpi brownish-yellow, latter slightly paler; nasus and palpi with numerous black hairs. Antennae bright yellow, base of all segments except 1st scapal jet black, the colour gradually fading away before the middle of each segment. Occiput greenish-grey.

Thorax and scutellum wholly bright brownish yellow.

Abdomen similar, 7th and 8th segments black. Belly similar, a little darker towards hind part of each segment. Genitalia large, conspicuous, brownish-yellow, with some concolorous pubescence; the moderate sized dorsal plate cut away in centre of hind margin, ending in two

points rather turned down; 2nd joint of claspers in the shape of a long curved tooth, drawn out into a very long slender horny point.

Legs brownish-yellow; femora with a rather broad brown apical ring, indistinctly defined proximally.

Wings yellowish-grey; costal cell yellow: stigma yellowish-brown: veins very distinct, dark brownish-black: 2nd posterior cell long and narrow, twice as long as its petiole, which latter is subequal in length to the discal cell: halteres yellow, clubs blackish.

Described from a single ♂ in the Indian Museum from Parambikulam, Cochin State, South India, 1,700—3,200 ft., 16—24-ix-14 (*Gravely*).

Tipula fasciculata, sp. nov.

♂ ♀. Darjiling. Long. 14 mm.

♂ *Head.*—Front of head and proboscis yellowish or yellowish-grey; occiput and frons dull greenish-grey, the colour extending forward in a point to between the antennae; occiput bearing some black hairs. Palpi brownish-yellow, last joint black. Antennal scape yellow, 1st flagellar joint yellowish, the remainder black.

Thorax dull yellowish or greyish; three dorsal stripes of the usual pattern, the median one narrowly divided, and the dorsal surface behind the suture pale dirty brownish-grey. Pleurae dull yellowish-grey, with almost a greenish reflection, a little yellowish contiguous to dorsum. Scutellum more whitish-grey, metanotum dull greenish with whitish-grey reflections.

Abdomen.—1st segment and from the 5th to the 8th blackish; 2nd, 3rd and 4th yellowish with a median dark stripe and a narrow side stripe. Belly mainly as dorsum. Genitalia rather large, a large square, curved dark brown dorsal plate with a pointed black piece bearing bright yellow hairs on each side, projecting below it. The claspers are tightly closed, the basal joint blackish grey with scattered bright yellow short hairs, the 2nd joint is brownish-yellow and there is a keel-shaped ventral plate.

Legs.—Coxae brownish-yellow, more or less grey in front, especially on fore pair; femora brownish-yellow, with a rather broad apical black ring; tibiae rather darker than femora; tarsi blackish.

Wings distinctly brownish, slightly darker along 5th longitudinal vein, no darker anteriorly; stigma almost imperceptibly darker. A pale curved streak from costa just before stigma and anterior cross vein, over basal half of discal cell, thence curving outwards along bases of 2nd, 3rd and 4th posterior cells, and faintly continuing along veinlet dividing 4th and 5th posterior cells. A similar streak embracing the 6th vein throughout its length. Halteres black.

♀. Body more greyish, nearly wholly so—including the whole abdomen; ovipositor shining chestnut brown with long yellow terminal sheaths.

Described chiefly from a type ♂ from Darjiling, 7,000 ft., 25-v-10 (*Brunetti*). A second ♂ is from Tonglu, Darjiling District, 10,000 ft., 21-iv-10 (*Beebe*); a third from Senchal, Darjiling District, 8,000 ft., v-13 (Lord Carmichael's coll.). A single (type) ♀ from the latter locality. All specimens in the Indian Museum.

Tipula brevis, sp. nov.

♂ ♀. Shillong, Assam. Long. ♂ 12 mm.; ♀ 15 mm. from tip of nasus to tip of ovipositor. Length of each wing 15 mm.

Head and proboscis brownish-yellow; labella with dark brown margins; palpi dirty yellow, gradually darkening to black at tips, black pubescent. Antennae yellowish, base of all scapal joints except 1st jet black, the colour fading away at about middle of each segment. In the ♀ the black is confined to a narrow basal ring. Occiput brownish-yellow, with narrow brown median stripe and some black pubescence towards eye margins.

Thorax.—Ground colour pale brownish-yellow; three olive brown stripes of the usual form, the centre one narrowly divided except on anterior margin; side stripes shorter anteriorly but extending to posterior margin. An obscure stripe extends in the ♀ from the neck to just below the wing base.

Abdomen in ♂ brownish-yellow, with a narrow blackish irregular dorsal stripe dying away at about middle of abdomen (type ♂); or dark mahogany brown with the dorsal part nearly black, and the last two or three segments wholly so. Belly brownish-yellow, tip blackish.

In ♀ abdomen brownish-yellow, with distinct and complete dorsal black stripe without well defined edges. Belly darker brownish-yellow. Genitalia in ♂ brownish-yellow, dorsal plate V-shaped with rounded edges bearing yellow pubescence; 2nd joint of claspers ending in a pair of broad thumb-like processes; ventral plate reduced to a long narrow style-like piece with yellow pubescence at tip.

Legs in ♂: coxae and femora yellowish, latter with a broad dark brown apical ring; tibiae and tarsi dark brown. In ♀, tibiae concolorous with femora, the apical ring on latter barely perceptible.

Wings pale grey; stigma brownish, ill defined; a barely perceptible pale streak just beyond stigmatic suffusion reaching from costa to discal cell; similar barely perceptible paler patches in 1st basal cell dividing it approximately into three parts; two or three similar pale spots on hind border of wing (two in 1st axillary and one in 2nd axillary cell). Costal cell very slightly yellowish. A small, just perceptibly darker grey spot at base of 2nd longitudinal vein and another contiguous proximally to the stigmatic suffusion. Halteres yellow, knobs blackish.

Described from 4 ♂ ♂ and one ♀ (the latter apparently rather immature) in the Indian Museum from Shillong, Assam, 4,900 ft., 10—12-x-14 (*Kemp*).

On **TIPULODINA**, Ender.[1]

There is a small group of species of *Tipula* with snowwhite to yellowish rings on the femora or tibiae or both, and long white tarsi, and though closely allied I have been able to distinguish six valid forms, *pedata*, W.,

[1] Since writing this page I have seen that Alexander noted in 1913 that *Tipulodina* was unquestionably a Tipuline, but I had overlooked his paper. He does not definitely state whether he regards it as a good genus or not.

venusta, Walk., *patricia* and *gracillima*, Brun., and two new ones, *contigua* and *simillima*. *T. inordinans*, Walk., *cinctipes*, Meij. from Borneo and *Tipulodina magnicornis*, End. also belong here. For this group Enderlein has set up the genus *Tipulodina*,[1] with the type species *magnicornis*, sp. nov., from Sumatra. The venation in this group, on which the new genus is partly founded, is merely that of *Tipula* itself.

In *Tipula* the auxiliary vein turns down very distinctly into the 1st vein a little beyond the origin of the praefurca, with no cross vein between it and the costa, though in some species a slight darkening of the inner end of the stigma or a fractional thickening of both costa and auxiliary at the same spot creates the impression of the presence of such a cross vein.

Out of many hundreds of good specimens of Tipulae examined I have never found any such cross vein.[2] The subcostal cross vein is invariably absent in *Tipula*. The 1st vein ends very distinctly in the 2nd either (1) where the latter forks, (2) immediately before the fork, or (3) in the upper branch of the fork just beyond its base, and in the latter case this short basal section may be mistaken for a cross vein, and the rest of the upper branch mistaken for the ending of the 1st vein. This view is wrong and I am compelled to consider Enderlein's reading of the venation in *Tipulodina* wholly incorrect. The costal cross vein is normally present in *Tipula* but often weak, possibly absent. In most of the species of the group under discussion the auxiliary vein lies so close to the 1st vein as to be easily overlooked, and this is especially the case in the form I provisionally identify as *pedata*, W. In my *gracillima* the 2nd vein is not forked quite in the ordinary way, the upper branch being abortive, short, whitish, thickened, lying along the outer margin of the stigma, and liable to be overlooked. In this species the costal cross vein is weak, situated just before the end of the stigma. In the very closely allied *simillima* the 2nd vein is forked in the usual way.

As regards the relative length of the 4th palpal joint, which in Enderlein's type species is said to be only a little longer than the 3rd, a better case is made out for the erection of a separate genus and its removal to another subfamily, but having carefully re-examined all the specimens of the six species at my disposal, I find the 4th joint in them varies from $1\frac{3}{4}$ to over twice the length of the 3rd, or in other words about as long as the 2nd and 3rd joints together, generally much thinner and always of the so-called " whip-lash like " or peculiarly tipuliniform nature.

Though the Tipulinae are theoretically separated from the Limnobiinae by the 4th palpal joint being " as long as or longer than the other three together," as a matter of fact in some species it is only as long as the preceding two, or slightly longer, and this closes the gap so far as the palpi go between this subfamily and the Limnobiinae in which it is theoretically " as long as the 2nd and 3rd together or slightly longer." Normally the 4th palpal joint may be regarded as as long as the preced-

[1] *Zool. Jahr.* XXXII, p. 30 (1912). It may be noted that Enderlein places his genus in the Amalopini (" Pediciinae ") Section of the subfamily Limnobiinae, and that Bezzi would refer it to the Dolichopezini.

[2] Of course, the humeral cross vein excluded.

ing three in Tipulinae and as long as the preceding two in Limnobiinae. This being so I think *Tipulodina magnicornis*, End. would be better placed in the present group of the genus *Tipula* as an abnormal species, and abnormal in the matter of the palpi only.

Moreover, the nasus in this group of Tipulae is very pronounced and this character is considered one of primary importance in the Tipulinae.

The fault of the Comstock-Needham system of venation is that it endeavours to enforce a similar interpretation of the veins in both Tipulinae and Limnobiinae. There is nothing illogical in a certain vein normally turning upwards at the tip in the one subfamily and normally downwards in the other, and if the courses of the auxiliary vein and 1st vein be studied in genera where the subcostal cross vein, costal cross vein and marginal cross vein are absent, it will be found they both turn downwards at the tip in the Tipulinae and upwards in the Limnobiinae, exactly as stated by Osten Sacken, in spite of Needham's effort to prove to the contrary and his statement that the great dipterologist's terminology has "served its day and generation." Osten Sacken also particularly warned students against forcing the same reading into different groups and skilfully pointed out the close analogy of the venation of both subfamilies; but what is the end of a certain vein in one subfamily is a cross vein in the other, and *vice versâ*.

The species in this group may be tabulated thus [1]: —

A. A brownish spot over both basal cells (not conspicuous but quite obvious and apparently constant).

B. Femora without pale rings. (Anterior tibiae brownish basally, remainder black, with broad white ring towards tips; all tarsi wholly white except basal third of metatarsus, but tarsi tips a little brownish and extreme tips black) . . . . . . *patricia*, Brun.

BB. Anterior femora with broad, subapical yellowish ring. (Ring yellowish, broader, less well defined; ring on anterior tibiae broad, subapical; tarsi wholly white except about basal half of anterior metatarsi and basal third of hind metatarsi) . . . *venusta*, Walk.

AA. No brownish spot over basal cells.

C. Femora unringed. (Anterior tibiae more uniformly concolorous dark brown (fore pair) or black (middle pair), with narrow white ring just beyond middle; anterior tarsi wholly brownish-yellow (fore pair) or dark brown (middle pair)) . . . . *contigua*, sp. nov.

CC. Femora ringed; at least front pair.

D. Front femora alone ringed. (The ring moderately broad, yellowish, apical; tarsi wholly white except basal half of anterior and basal third of hind metatarsi black; extreme tips of tarsi may be brown or black). Costal cell wholly deep black. . . *pedata*, W.[2]

DD. Anterior femora very distinctly ringed (indistinctly also on hind pair, the ring subapical). Costal cell wholly clear.

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[1] As the legs were broken off in *magnicornis*, Hend. it is impossible to include it in the above table.

[2] My identification of this species still requires *absolute* confirmation. Meijere recognises it from Java on several occasions and says the front femora are not white ringed, but Osten Sacken says they have a subapical yellowish-white ring, Wiedemann noting only the tibial rings. The femoral ring is not conspicuous, but is obvious enough if looked for. Osten Sacken's note of the very close approximation of the auxiliary vein to the 1st longitudinal will also apply to other species in this group and to some Tipulae of other groups also.

E. Origin of 2nd vein hidden by stigma filling all marginal cell; upper branch of 2nd vein very short, abortive, thickened, whitish. Femoral rings very narrow, more whitish; tarsi all white except basal part of metatarsi . . . . *gracillima*, Brun.
EE. Origin of 2nd vein easily seen, as stigma fills only apical half of marginal cell; 2nd vein forked in the ordinary way; femoral rings twice as broad as in *gracillima*, more yellowish; tarsi with base of 2nd joint broadly and distinctly black, more narrowly so on hind pair . . . . *simillima*, sp. nov.

In reading "tarsi all white", etc., in above table it must be remembered that the *extreme* tips may be brownish or blackish, this point having no material value.

Venusta, Walk. is extremely like *pedata*, W. but they may be differentiated as follows :—

Costal cell all black; no spot over basal cells . . *pedata*
Costal cell clear; a spot over basal cells . . . . *venusta*.

I now consider my first impression of *venusta*, Walk. probably correct and that my figure of it [1] really represents that species.

LONGURIO, Lw.

Berl. Ent. Zeits. XIII, p. 3 (1869).

Genotype: *L. testaceus*, Lw., sp. nov.

rubriceps, Edw., *Ann. Mag. Nat. Hist.* (8) XVIII, p. 261 ♂, pl. xii, 9, genitalia (1916). Shiuten, Formosa, 400 ft. (*Shiraki*). The unique type in the British Museum.

BRITHURA, Edw.

Ann. Mag. Nat. Hist. (8) XVIII, p. 262 (1916).

Genotype: *B. conifrons*, Edw., sp. nov.

conifrons, Edw., *loc. cit.*, p. 263, ♂, pl. xii, 10, tip of abdomen, 11, tip of wing (1916). Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*). Unique type in British Museum.

crassa, Edw., *loc. cit.*, p. 264, ♂, pl. xii, 12, abdomen tip (1916). Described from a unique ♂ in the British Museum labelled "East Indies," (? India).

PACHYRHINA, Macq.

In my "Fauna" volume were added the following new species, *serricornis*, p. 341 ♂, India (var. locs.); *puncticornis*, p. 343 ♂, Siliguri, Bengal; *pleurinotata*, p. 343 ♂ ♀, Ceylon; *demarcata*, p. 344 ♂ ♀, Darjiling; *concolorithorax*, p. 346 ♂ ♀, Khasi Hills, Sylhet; *gamma*, p. 347 ♀, Assam-Bhutan Frontier: the types of all (except *concolorithorax* ♂ in the Pusa coll.) being in the Indian Museum.

speculata, Meij., *Nova Guin. Res.* IX, p. 314 ♀ (1913). Papua.

ochripleuris, de Meij., *Tijd. v. Ent.* LVI, Supp. p. 6 ♂ ♀, 1913 (Mar. 1914). Java.

[1] *Fauna Brit. Ind. Dipt.*, pl. v, fig. 5, wing.

citrina, Edw., *Ann. Mag. Nat. Hist.* (8) XVIII, p. 265 ♀, (1916). Taihoku, Formosa (*Shiraki*). Unique type in British Museum.

parva, Edw., *loc. cit.*, p. 266, ♂ (1916). Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*). Unique type in British Museum.

formosensis, Edw., *loc. cit.*, p. 267, ♀ (1916). Kammotu, Formosa, 10-iv-10 (*Nitobe*). Unique type in British Museum.

Tipula cinerea, Brun. and **T. elegans,** Brun.

Mr. Alexander writes me that these names should be altered on account of *Tipula cinerea*, Fab. which=*Trichocera maculipennis*, Mg. and *Tipula elegans*, Fab. which is a *Pachyrhina*, but this seems carrying the principle of renaming a little too far.

Pachyrhina javensis, Dol.

A ♀ from Coonoor, Nilgiri Hills, vi-12 (*Capt. Sewell*) in the Indian Museum differs from the three ♀ ♀ referred by me to this species by having a black spot on the sternopleura as in *pleurinotata*. The fore femora are nearly black except for the pale basal fourth and a slightly lighter space before the tip, sufficient to give the impression of a broad black median ring. The posterior femora are brownish-yellow with a moderately broad distinct apical ring. The 2nd posterior cell is not petiolate. The scutellum is wholly shining black. Two further ♀ ♀ from the same locality (1 and 4-ix-11, *Howlett*) shew other minor differences, so the species is evidently a variable one. Three ♂ ♂ also from Coonoor (4 and 5-ix-11, *Howlett*) may possibly belong here ; they are rather smaller than the ♀ and I have not seen any ♂ that could definitely be referred to *javensis*. Edwards records this species with notes (*Ann. Mag. Nat. Hist.* (8) XVIII, 266) from Kotosho Island, near Formosa, 20-vii-12 (*Shiraki*).

Two ♀ ♀ from Tura, Garo Hills, Assam, 1,400 ft., ix-17 (*Mrs. Kemp*) have the thoracic dorsum almost entirely shining black, and the front femora shew no trace of black, yet they are probably this species.

Pachyrhina bombayensis, Macq.

This species is common at Pusa, Bihar, in July, August and September.

Pachyrhina serricornis, Brun.

A small series from Pusa, February, September and December. One specimen from Shillong, 19-x-11.

Pachyrhina pleurinotata, Brun.

A second ♂ and ♀ in the Indian Museum also from Namoya, Ceylon, the ♀ having an abnormal, broad, blackish band in the middle of the fore femora.

Pachyrhina dorsopunctata, Brun.

A ♂ from Mangaldai, Assam-Bhutan Frontier, 30, 31-xii-10 (*Kemp*). Two ♀♀ Dinapore, Bengal, 16-xii-14 to 23-i-15 (*Caunter*); Pusa, Bengal, 5—10-ii-15 ♂ ♀ *in cop.* (*Gravely*).

The species is common at Pusa in February and March.

Pachyrhina consimilis, Brun.

Cherrapunji, Assam, 4,400 ft., 2-3-x-14 (*Kemp*); Shillong, 5,500—6,400 ft., 29-viii to 5-ix-15 (*Kemp*); near Ghoom, above Darjiling, 6,000—7,000 ft., 11-vi-14 (*Gravely*); Kurseong, 4,700—5,000 ft., 19-vi-10; 4-ix-09 (both *Annandale*); Kalimpong, Darjiling District, 600—4,500 ft., 24-iv—10-v-15 (*Gravely*); Pashok, Darjiling District, 2,000—3,500 ft., 23-iv—11-v-15 (*Gravely*). I found it abundant at Darjiling during the first week in June, 1917.

Pachyrhina gamma, Brun.

This must temporarily be regarded as an indefinite species of which the description may require modification as further specimens have turned up which may belong to it and which would give it a considerable amount of variation. The inverted Y-mark mentioned in the type is on the *face* and not on the frons as described.

Pachyrhina virgata, Coq.

Proc. U. S. Nat. Mus. XXI, p. 306 (1898).

Edwards records this, with notes (*Ann. Mag. Nat. Hist.* (8) XVIII, p. 266) from Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*).

Pachyrhina fuscoflava, sp. nov.

♀. Punjab, India. Long. 18 mm. to tip of ovipositor.

Head.—Brownish-yellow, with a little black pubescence; base of flagellar joints of antennae narrowly black.

Thorax brownish-yellow, the usual three darker stripes rather indistinct, the outer ones not produced forward or downward.

Abdomen darker brownish-yellow with brownish or blackish markings; ovipositor shining lighter brown.

Legs brownish-yellow; tips of femora, of tibiae, and of 1st and 2nd tarsal joints blackish; remainder of tarsi wholly black.

Wings pale yellowish-grey; a whitish streak from costa just beyond tip of 1st longitudinal vein, downwards to a little below discal cell; also a similar paleness at tip of costal cell and base of marginal cell. A less distinct whitish spot lying over both basal cells at about two-thirds of their length, with a still fainter one at about one-third of their length. No distinct stigma but stigmatic region a little brownish. Halteres brownish-yellow, the centre of the clubs darker.

Described from two ♀♀ sent by Mr. Bainbrigge Fletcher from the Hazara District, Dungagali, 8,000 ft., 21-24-v-15. *Type* presented by Mr. Fletcher to the British Museum, cotype in the Pusa collection.

A species quite distinct from the others but yet possessing no strikingly distinctive character.

Pachyrhina parvinotata, sp. nov.

♂ ♀. N.-W. Indian Frontier. Long. 15 mm. to tip of ovipositor.

This species bears a considerable resemblance to my *dorsopunctata*, but differs essentially as follows.

♀. The outer thoracic stripes curve distinctly downwards at their tips and are brown not black, in some specimens less distinct than the median stripe; the abdominal marks are small and rounded, not triangular (in *dorsopunctata* they sometimes nearly cover the dorsum of the segment); the 2nd posterior cell is much shorter, barely twice as long as the discal cell.

These differences appear constant in the four females before me, three coming from Taru, Peshawar District, 16—29-v-15 and one from Haripur Hazara, North-West Frontier 27-v-15.

What is no doubt a male of the same species has the abdomen almost wholly brownish-yellow, without distinct spots, the last two segments being black above. It is from Taru taken in company with the females.

Type ♂ and ♀ presented by Mr. Fletcher to the British Museum, cotypes in Pusa collection.

Pachyrhina hypocrites, sp. nov.

♂ ♀. Darjiling. Long. 10-11 mm.

Head, palpi and antennae black, but frons more or less dull brownish-orange.

Thorax and *abdomen* bright orange, last three or four abdominal segments and genitalia black.

Legs black; coxae, trochanters and femora for a short distance at base orange.

Wings moderately dark grey, stigma distinct but not conspicuous, blackish; halteres blackish.

Described from 3 ♂♂ and 2 ♀♀ from Sureil, Darjiling District, 5,000 ft., iv-v-17 (*Kemp*). In the Indian Museum.

This species is extraordinarily like a specimen taken at the same time which I have identified as probably *Tipula melanomera*, Walk. only the different venation and structure of the genitalia separating them.

Section *DOLICHOPEZINI.*

MITOPEZA, Edw., gen. nov.

Ann. Mag. Nat. Hist. (8) XVII, ♀ p. 349 and 350, ♀ fig. 1, p. 356, genitalia (1916).

nitidirostris, Edw., *loc. cit.*, Kedah Peak, 3,200 ft., Malay Peninsula (*Dr. Stanton*). Unique type in British Museum.

Tanypremna omissinervis, Meij.

Dr. de Meijere now refers this to *Tipula.*

Alexander (*Proc. U. S. N. M.* XLIV, p. 487) sinks *Stegasmonotus*, Ender. (*Zool. Jahr.* XXXII, p. 1, fig. i ; 1912) as an absolute synonym of *Tanypremna.*

DOLICHOPEZA, Curt.

• **orientalis,** Brun., *Fauna Brit. Ind. Dipt.*, p. 354 ♂ ♀ (1912). Kurseong.

I found this species not uncommon at Darjiling during the second week of July 1916, flying low and slowly over wet grass and plants on the hillside in the town.

obscura, Brun., *loc. cit.*, p. 355 ♂ ♀ (1912). Kurseong.
postica, *id.*, *loc. cit.*, App. p. 564 ♂ ♀ (1912). Darjiling District.
infuscata, *id.*, *loc. cit.*, App. p. 565 ♂ (1912). Nilgiri Hills.

Types of above four species in Indian Museum.

pallidithorax, Meij., *Tijd. v. Ent.* LVI, Supp. p. 4 ♂, pl. i, 3, 1913 (Mar. 1914). Java.

Dolichopeza costalis, sp. nov.

(Plate viii, fig. 6.)

♂. Cochin, S. India. Long. just over 5 mm.

Head yellowish ; frontal bump well developed. Proboscis dirty brownish-yellow, with a few bristly black hairs ; palpi brownish-yellow, paler at emarginations. Antennae pale yellowish with soft white pubescence, a little blackish at emarginations ; 1st joint pale brownish, with bristly hairs.

Thorax and scutellum wholly pale brownish-yellow

Abdomen yellowish at base, remainder of segment smoke-brown, paler on basal part of each segment. Genitalia distinct, smoke-brown.

Legs (one only remaining). Femora yellowish, tip distinctly brown, tibiae and tarsi whitish, tip of former narrowly black ; tarsi $1\frac{1}{2}$ times as long as tibiae.

Wings pale grey ; costa smoke-brown, the colour broadening towards and broadly enclosing wing tip, filling apical half of 1st and apical third of 2nd posterior cell. Wing brown at base ; a blob attached to the costal darkening placed a little beyond the basal dark part ; a 2nd blob over origin of 2nd longitudinal vein, a 3rd over anterior cross vein and base of 1st posterior cell. The posterior cross vein is narrowly brown suffused, and there is a minute concolorous spot placed at each of the three hindermost veinlets of the 4th vein, also at tips of 5th and 6th longitudinal veins.

A slightly paler spot than the ground colour on costa just beyond tip of 1st vein and one each at tips of submarginal and 1st posterior cells.

Described from a unique ♂ in the Indian Museum from Kavalai, 1,300—3,000 ft., Cochin State, S. India, 24—27-ix-14 (*Gravely*).

Apart from only one leg remaining the specimen is in good condition but I should have refrained from setting up a legless type if the species

had not been such a striking one by the wing markings, and the genus so limited.

NESOPEZA, Alex.

Can. Ent. XLVI, p. 157 (1914).

Alexander makes Meijere's *Dolichopeza gracilis* the type of this genus.

Nesopeza albitarsis, sp. nov.

(Plate vii, fig. 1.)

♂ ♀. Darjiling. Long. about 8 mm.

Head.—Occiput and frons brownish-grey ; former with a few short stiff hairs and traces of a median dark stripe ; remainder of head brownish-yellow ; proboscis with some black stiff hairs above ; palpi blackish-grey.

Thorax, scutellum and metanotum uniformly brownish-yellow ; pleurae paler and more greyish. Two well separated dorso-central stripes of short pale hairs.

Abdomen blackish, with inconspicuous whitish pubescence which is longer and more yellowish on hinder segments. Base of abdomen and posterior margins of hinder segments slightly paler. Genitalia in ♂ of moderate size, brownish-yellow, with yellowish pubescence, apparently complex ; ovipositor shining yellowish-brown.

Legs.—Femora brownish-yellow, darker at tips ; tibiae much darker, pale at base, blackish at tips ; tarsi all white to extreme tips.

Wings pale yellowish-grey ; stigma well defined, a small paler contiguous spot in front of and beyond it. Halteres yellow, knobs blackish.

Described from a unique pair in the Indian Museum from Lord Carmichael's collection ; the ♂ from Lebong, Darjiling District, 6,000—6,600 ft., 13-vi-14 (*Gravely*), the ♀ from between Darjiling and Soom, 5,000—7,000 ft., 14-vi-14 (*Gravely*). This species apparently comes in *Nesopeza* although the 2nd longitudinal vein originates more distally than in *gracilis,* in fact only immediately before the origin of the 3rd.

Nesopeza longicornis, sp. nov.

♂. Assam. Long. 9 mm.

Body wholly dark dull nut-brown ; a little brownish-yellow about nasus and underside of head. Antennae longer than whole body, brown ; flagellum of ten very elongate subequal joints with very short erect pubescence and two moderately long verticils on each placed respectively just after the base and just beyond the middle ; 11th joint very minute. Traces of a divided pale median stripe on dorsum of thorax. Hind segments of abdomen narrowly and indistinctly black ; genitalia of moderate size. Femora black, tibiae pale yellowish, becoming white at tips ; tarsi wholly snow-white, longer than femora and tibiae together. Wings pale yellowish-grey ; stigma black, the ground colour of the wing on each side of it whitish. 2nd vein originating some distance before 3rd ; 2nd posterior cell truncate at base, as long as 3rd ; discal cell small,

indistinct at base, lower side wholly formed by 4th posterior cell; posterior cross vein a little before base of discal cell. Halteres dark brown.

Described from three ♂ ♂ in the Indian Museum from above Tura, Garo Hills, Assam, 3,500—3,900 ft., vii-1917 (*Kemp*).

Nesopeza picticornis, sp. nov.

♂. Southern Shan States. Long. 9 mm.

Head brownish-yellow; a median blackish stripe on frons extending back across most of occiput; nasus dirty brown, palpi blackish. Antennae bright yellow, base of all flagellar joints except 1st black ringed at base, also slightly swollen there; apical joint exceedingly minute, yellowish.

Thorax.—Collare blackish; dorsum yellowish with three distinct but not clear-cut stripes of the usual pattern; the median one extending to anterior margin and continued downwards over shoulders; posterior calli dark brown, the intermediate depression yellowish, as is also the rather square shaped scutellum. Sides of thorax brownish-yellow; an indistinct blackish streak from prothorax across the pleurae and joining the dark abdominal side streak. Metanotum large, shield-shaped, brownish-yellow with black edges.

Abdomen brownish-yellow, hind margin of each segment with a distinct bluish-black band; belly similar; sides with a narrow blackish line from base nearly to tip. Genitalia small, brownish-yellow.

Legs.—Coxae and femora brownish-yellow, latter dark brown tipped; tibiae and tarsi very dark brown or black.

Wings moderately dark grey; veins distinct, black; subcostal cell blackish; stigma clear-cut, oval, black; posterior cross vein slightly suffused; anterior, outer and hinder sides of discal cell rather faint. Halteres yellowish, clubs blackish with white tips.

Described from a single ♂ in the Indian Museum from Inle, Southern Shan States, 3,000 ft., 18-ii-17 (*Gravely*). This is a more robust species than *albitarsis*, and the legs are relatively shorter.

SCAMBONEURA, Os. Sac.

quadrata, de Meij., *Tijd. v. Ent.* LVI, Supp. p. 8, 1913 (Mar. 1914). Java.

Subfamily LIMNOBIINAE.

Section *CYLINDROTOMINI.*

STIBADOCERA, Ender.

Zool. Jahr. XXXII, p. 83 (1912).

Genotype: *S. bullans*, sp. nov.

bullans, Ender., *loc. cit.*, p. 84 ♂ (1912). Sumatra. The unique type in the Stettin Zoological Museum.

metallica, Alex., *Proc. U. S. Nat. Mus.* XLIX, p. 178 (1916). Java.

Alexander states in this paper that my *Cylindrotoma quadricellula* is a *Stibadocera.*

Genera in CYLINDROTOMINI.

An examination of the genera and species in this group reveals a remarkable elasticity of characters and substantiates its intermediate position between Tipulinae and Limnobiinae.

This was quite evident to Osten Sacken who,[1] in comparing the European *Cylindrotoma distinctissima* with the North American *americana,* also the European *glabrata* with the North American *nodicornis,* wrote " The fact is that these species represent a gradation which baffles every attempt at a generic arrangement." He retained *Phalacrocera tipulina* and the European *P. replicata* in the same genus in spite of the important difference that in the former the 1st vein ends in the 2nd vein, with the marginal cross vein absent, whilst in *replicata* the 1st vein ends in the costa with the marginal cross vein present. He kept all the species known at that time in the three genera recognised by Schiner, *Cylindrotoma, Phalacrocera* and *Triogma* " in order to avoid the establishment of a new genus for almost every species known, which would probably necessitate a similar process for every species to be discovered hereafter." He notes that even the absence of the anterior cross vein (when it is normally absent) is not always constant in the same species, as out of twenty-one examples of *Liogma nodicornis* examined it was absent in seventeen and present, though short, in four, so he retains *nodicornis* and *glabrata* (in which latter the vein is present) in the same genus *Liogma.*

The characters of this group which exhibit such unusual variation are : (1) the exact manner in which the auxiliary vein terminates, with the presence or absence of the subcostal cross vein, or the presence or otherwise of a short cross vein between the tip of the auxiliary vein and the costa ; (2) the exact manner in which the 1st vein terminates, with the presence or absence of what I call in my Fauna volume the costal cross vein ; (3) the point at which the 2nd and 3rd veins diverge, and, (4) the presence or absence of the anterior cross vein. Other characters though variable are definite one way or the other, such as the number (four or five) of posterior cells, the punctulate nature of the thorax or otherwise, and some minor ones. All the tibiae are spurred in the three species before me.

The material before me, apart from literature, consists of a single specimen of *C. distinctissima* (with one wing only), the three original specimens of my *C. 4-cellula,*[2] and four ♂ ♂ and one ♀ of my new species *latefurcata.* These exhibit the following comparative characters.

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[1] *Monog. N. Am. Tipulidae,* p. 295.

[2] This is a *Stibadocera* as Alexander notes. I had not seen Enderlein's paper, nor an earlier paper by Alexander on Neotropical Limnobiinae in which he doubts the Cylindrotomine character of the genus, though he admits its position here in his subsequent paper on Javan Tipulidae.

Cylindrotoma distinctissima, Mg.—Auxiliary vein ends free, a trace of subcostal cross vein towards but not at tip. (Extreme tip of wing missing, but intact up to the point at which costal cross vein occurs when present, and there is no sign of it.) 2nd and 3rd veins diverge immediately but distinctly before anterior cross vein. Antennae with moderately long verticils, inconspicuous as such. Thorax quite smooth, unpunctured.

Stibadocera 4-cellula, Brun.—Auxiliary vein distinctly turns down into 1st vein, without weakening, no trace of a cross vein uniting it with costa. 1st vein dark brown till near tip, where it turns down into 2nd vein, this last section of it pale yellow. A dark brown cross vein (my costal cross vein) joins it to costa at the point where it suddenly pales. Therefore if it is contended that in this case the 1st vein ends in the costa, the pale apical section will be the marginal cross vein, but the former theory strikes me as the more correct. 2nd and 3rd veins diverge exactly at anterior cross vein. Thorax towards sides of dorsum distinctly punctulate. Antennae very long with exceptionally long and conspicuous verticils.

Stibadocerella pristina, sp. nov.—Auxiliary vein may be considered to end in costa with subcostal cross vein present, both of equal strength and distinctness, though it is impossible to decide with certainty which is the actual ending of the vein. The 1st vein obviously turns down into the 2nd; no trace of costal cross vein. The peculiarity of this species is that the 2nd and 3rd veins diverge so late, half way between anterior cross vein and wing tip. The 2nd vein at point of divergence turns abruptly upwards and then rather sharply outwards, the last section appearing to be the end of the 1st vein, being in a straight line with it. 3rd vein forming with praefurca a gently bisinuate line. Rest of veins as in *4-cellula.*

Antennae in ♂ as in *4-cellula*; longer than whole body; in ♀ less than half as long, very shortly and inconspicuously pubescent. Thorax very smooth, no trace of punctulation.

The variation of the characters in question may be summed up as follows.[1]

Auxiliary vein.—Ends (1) free, with subcostal cross vein indistinctly present (*Cylindrotoma*); or (2) ends very distinctly in the 1st vein without any cross vein above or below, and as three out of the six genera in this section are identical in this it may be regarded as the normal ending (*Triogma, Liogma, Stibadocera*); or (3) ends in costa with subcostal cross vein present (*Stibadocerella*). It may be contended in the latter case that it ends in the 1st vein, with a supernumerary cross vein between its tip and the costa, but such a cross vein is very rare in the diptera.

1st longitudinal vein.—Normally ends in 2nd vein.[2] When the costal cross vein is absent this fact is unimpeachable, therefore Enderlein's contention that it ends in the costa with a cross vein between it

[1] Only the conclusions are given here, as my full comparative notes on the genera would occupy too much space.

[2] Occasional exceptions may be admitted: *vide* note *antea* p. 280, *Phalacrocera.*

and the 2nd vein (which would be the marginal cross vein) must be incorrect.

Osten Sacken admits a "more or less indistinct cross vein connects the 1st vein with the costa."

This is my costal cross vein which is present (*Cylindrotoma*, indistinctly; *Stibadocera*), or absent (*Triogma, Liogma, Stibadocerella*).

2nd and 3rd veins.—These diverge at varying distances, as is the case in many other groups, either just before, or at, or a little beyond the anterior cross vein (all genera except *Stibadocerella*) or else half way between the anterior cross vein and the wing-tip as in the latter genus.

Anterior cross vein.—Normally present, but absent in *Triogma* and *Liogma*, effectually characterising these genera though, as has been stated, it is not always constant even in the same species.

Number of posterior cells.—Four in all genera except *Cylindrotoma*, which has five.

Antennae.—These have conspicuously long and copious verticils in *Stibadocera* and *Stibadocerella*, but they afford no characters out of the common in the other genera.

Punctulation of thorax.—This very unusual character in Tipulidae exists only in *Triogma, Liogma* and *Stibadocerella.*

On the above general conclusions the following table of genera may be offered :—

A. Anterior cross vein absent [1] : thorax punctulate.	
B. Flagellar joints subglobular [2]	*Triogma.*
BB. Flagellar joints subcylindrical, elongate . . .	*Liogma.*
AA. Anterior cross vein present : thorax not punctulate except in *Stibadocera.*	
C. Five posterior cells	*Cylindrotoma.*
CC. Four posterior cells.	
D. Thorax punctulate	*Stibadocera.*
DD. Thorax not punctulate.	
E. Verticils of antennae very short : 2nd and 3rd veins diverging at about anterior cross vein . . .	*Phalacrocera.*
EE. Verticils of antennae very long and conspicuous : 2nd and 3rd veins diverging half way between anterior cross vein and wing tip	*Stibadocerella.*

In Osten Sacken's figure of his *Liogma nodicornis* [3] he shews the auxiliary vein distinctly ending free without any trace of a cross vein above or below, but Needham's figure of the same species shews the auxiliary vein as distinctly ending in the costa with a very distinct subcostal cross vein present. I cannot decide which is correct.

Enderlein's interpretation of the venation in *Stibadocera* is open to doubt. He speaks of the 2nd vein being joined to the 1st by a cross vein (which would, of course, be the marginal cross vein, though he does not recognise it as such). What he considers the tip of the 1st vein is really the costal cross vein, the 1st vein really ending in the 2nd as normally in this section. Alexander's figure of *S. metallica*, sp. nov. agrees in venation with Enderlein's species, *bullans*, from Sumatra.

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[1] Present occasionally in individual specimens in one species.

[2] The difference between *Triogma* and *Liogma* is weak but no other appears to have been put forward. Osten Sacken gives no definite character by which to separate them.

[3] "*Cylindrotoma*" *nodicornis.*, Monog., pl. i, 7.

I contend it must be admitted that the 1st vein normally and actually ends in the 2nd, because whenever the costal cross vein is absent it most obviously does so end.

STIBADOCERELLA, gen. nov.

Near *Stibadocera*, Enderl. Antennae with similar very long and conspicuous verticils the whole length of the flagellum, which consists of 13 joints, the last three not so distinctly demarcated as the others; scape as in *Stibadocera.* Thorax absolutely without trace of punctulation. All tibiae with very small spurs. Palpi comparatively short, all the joints apparently subequal. Auxiliary vein turning up very distinctly into costa; subcostal cross vein distinctly present; 1st vein turning down into 2nd as usual in this section; no trace whatever of costal cross vein; 2nd and 3rd veins diverging very late, half way between anterior cross vein and wing tip. As the wing is absolutely colourless (in the type and only species) all the veins stand out with striking clearness.

Genotype: *S. pristina*, sp. nov. ♂ ♀ from Assam.

Stibadocerella pristina, sp. nov.

♂ ♀. Assam. Long. 10 mm.

Head pale yellowish, face with a greenish tinge; palpi brownish, paler at tip; antenna. scape yellowish, flagellum brown.

Thorax pale brownish-yellow, very smooth and shining, traces of three shining, rather dark brown median, subcontiguous stripes, less distinct in ♀.

Abdomen dirty brown, hind margins of segments narrowly whitish, more distinct in ♂, and broader on the long 2nd and 3rd segments. (There seems no clear demarcation between what are apparently the first three segments.) Tip of abdomen blackish; genitalia in ♂ small but distinct; in ♀ comparatively large, bulbous at base, the valves black, shining.

Legs.—Coxae greenish (light verdigris colour); rest of legs brown. Femora a little pale at extreme base, and slightly thickened towards tips; tibiae with a very narrow white ring at extreme base (in one ♂ the ring is greenish); front tibiae with broad white ring at tip, where the pubescence is longer and thicker. Tarsi snow-white, anterior metatarsi brown except extreme tips, hind metatarsi brown to just beyond middle.

Wings absolutely colourless, veins extremely distinct, in accordance with the generic diagnosis; halteres black, stem comparatively long.

Described from four ♂ ♂ and one ♀ in Indian Museum from Tura, Garo Hills, Assam, 3,500—3,900 ft., vii-17 (*Kemp*).

Section *LIMNOBIINI.*

DICRANOMYIA, Steph.

In my Fauna volume (1912) I described the following species.

Marmoripennis, p. 369 ♂ ♀, Darjiling[1]; *demarcata*, p. 370 ♀, Kurseong; *absens*, p. 372 ♀, Kurseong; *pulchripennis*, p. 376 ♂ ♀, E. and W. Himalayas; *puncticosta*, p. 377 ♂ ♀, Kurseong; *fraterna*, p. 378 ♀, Darjiling; *fascipennis*, p. 379 ♀, Kurseong; *subfascipennis*, p. 380 ♂ ♀, Kurseong; *ornatipes*, p. 380 ♂, Travancore; Puri; Dawna Hills; *cinerascens*, p. 381 ♂ ♀ Darjiling; Kurseong; *cinctiventris*,[2] 382 ♀, Kurseong; *sordida*, p. 382, Darjiling; Kurseong; *delicata*, p. 383 ♂ ♀, Darjiling; *flavobrunnea*, p. 384 ♂ ♀, Calcutta; *simplex*, p. 384 ♀, Calcutta; *fortis*, p. 385 ♂, Darjiling; *nigrithorax*, p. 385 ♂, Darjiling; *subtessellata*, *l. c.*, App. p. 565 ♂ ♀, Ceylon; *bicinctipes*,[3] App. p. 566 ♂, Dawna Hills; *columbina*, App. p. 567 ♀, Ceylon; *approximata*, App. p. 567 ♀, Darjiling District; *innocens*, App. p. 568 ♂ ♀, Kumaon District. All the types in the Indian Museum.

debeauforti, de Meij., *Bijd. tot. Dierk.* XIX, p. 47, ♂ ♀ (1913). Saonek, Indo-Australian archipelago.

alta, de Meij., *Tijd. v. Ent.* LVI, p. 341 ♂ (1913). Java.

nongkodjadjarensis, *id.*, *l. c.*, p. 343 ♂ (1913). Java.

Types of the latter two species in Amsterdam Museum.

novae-guineae, de Meij., *Tijd. v. Ent.* LVIII, p. 101 (*Thrypticomyia*), (1915). North Papua.

tinctipennis, de Meij., *Tijd. v. Ent.* LVIII, Supp. p. 66, 1915 (1916). Sumatra.

Alexander describes the following new species from Java (*Proc. U. S. Nat. Mus.* XLIX, 1916): *albitarsis*, p. 159 ♂; *atrescens*, p. 160 ♂; *erythrina*, p. 161 ♂; *excelsa*, p. 161 ♂ ♀; *simplissima*, p. 162 ♀; *carneotincta*, p. 162 ♂.

Dicranomyia fullowayi, Alex.

Can. Ent. XLVII, p. 79 (1915).

Edwards records this species (*Ann. Mag. Nat. Hist.* (8) XVIII, p. 245) from Arisan, Formosa, 8,000 ft., 10-x-12 (*I. Nitobe*). Described originally (*Can. Ent.* XLVII, p. 79) from Guam I., one of the Ladrones Islands.

Edwards also describes in the same paper (p. 246) *D. alticola*, sp. nov. ♀, pl. xii, 1, ♀ genitalia), Arisan, 10-x-12 (*I. Nitobe*); Horisha, Formosa, v 1913 (*M. Maki*). Type in British Museum.

Dicranomyia cuneiformis, de Meij.

A few of each sex referable to this species from Castle Rock, Bombay, 11—26-x-16 (*Kemp*). In addition there is a ♂ with the marginal cell twice as much longer than the submarginal as the latter is longer than the 1st posterior. The whole wing tip is brownish infuscated as far basally as a line from the well marked stigma through the discal cell to just before the tip of the 5th longitudinal vein. Two other specimens have the marginal cell still longer proportionately and no trace of apical infuscation of the wing. All are from Castle Rock or neighbourhood, taken at about the same time.

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[1] This species was taken in Japan at Otsu, near Kyoto, x-15, by Dr. Annandale.

[2] This is a *Limnobia*, with *L. vitripennis*, Brun. as a synonym.

[3] Also described as new in *Rec. Ind. Mus.* VII, 447; the *Fauna* record antedates this by about a month.

Dicranomyia bicolor, sp. nov.

♂. Assam. Long. 6½ mm.

Head, proboscis, palpi and occiput dirty dark brown; antennae similar with a little pale pubescence.

Thorax pale yellowish; whole dorsum (except anterior margin broadly and the humeri), scutellum and metanotum shining black. Pleurae just above anterior coxae faintly blackish.

Abdomen.—Dorsum shining black, hind margins of segments yellowish; belly wholly yellow. Genitalia large, conspicuous, 2nd joint of claspers with two (if not three) hook-like appendages; a narrow long ventral plate.

Legs yellowish, gradually darkening to tarsi tips; tips of femora with a moderately broad blackish ring.

Wings pale grey very iridescent. 2nd longitudinal vein originating rectangularly and forming a right angle near its base, which is enclosed in a rather large blackish square spot. A similar spot over marginal cross-vein, continued narrowly over base of 3rd vein. Halteres pale yellow, knobs blackish.

Described from a unique ♂ in the Indian Museum, Cherrapunji, Assam, 4,400 ft., 2—8-x-14 (*Kemp*).

Allied to *D. nigrithorax*, Brun.

Dicranomyia prominens, sp. nov.

♂ ♀. Goa. Long. 3—4 mm.

Head set very low on thorax, on long neck; yellowish, as are also antennae, proboscis and palpi.

Thorax brownish-yellow, unusually humped and projecting forward considerably over the long neck.

Abdomen in ♂ wholly brownish-yellow, hind margins of segments barely darker; in ♀ wholly black except tip and genitals brownish-yellow.

Legs brownish-yellow.

Wings pale grey, without trace of stigma or markings; 4th longitudinal vein with both branches unforked; discal cell absent; halteres dirty yellow.

Described from 1 ♂ and 3 ♀♀ in the Indian Museum from Mormugao, Goa, ix-16 (*Kemp*).

This species is noticeable on account of the unusual convexity and prominence of the anterior part of the thorax which almost overhangs the neck. Another unusual character is the unforked nature of both branches of the 4th vein, which it possesses in common with *D. tenella*, de Meij., described from Java and not known from India. The latter has a distinct stigma, blackish-brown antennae and palpi, yellowish abdomen in both sexes and dark brown legs.

Dicranomyia niveiapicalis, sp. nov.

♂. S. W. India. Long. 4 mm.

Head yellowish-grey, vertex blackish; scapal joints of antennae very large, 1st much longer than usual; base of flagellum forming an

elongated cone, joints not easily separated, apical half of flagellum with very attenuated joints, of which the verticillate hairs are very long. Palpi black.

Thorax with dorsum somewhat sharply delimited from lower part, rather bright yellowish-grey, microscopically tomentose. A transverse row of four narrow vittae in front of suture, also an anterior pair towards front margin ; a slightly curved similar pair just behind suture. Scutellum and metanotum concolorous, latter blackish in middle.

Abdomen blackish with a rather broad median brownish-yellow stripe throughout its length. Genitalia brownish-yellow.

Legs yellowish, coxae pale whitish-yellow ; femora browner towards tips with a rather narrow apical snow-white ring.

Wings yellowish-grey ; small blackish suffusions over bases of 2nd and 3rd veins and tip of 1st vein, anterior and posterior cross veins, proximal and distal sides of discal cell, and tips of all veins. A much fainter sub-apical short stripe from costa reaching 1st posterior cell ; costal cell distinctly yellowish ; halteres brownish-yellow with darker tips.

Described from a single perfect ♂ in the Indian Museum from the North Canara District, S. W. India, 11—26-x-16 (*Kemp*).

The yellow colour of this species, with the spotted thorax and snow-white tipped femora make this a very conspicuous one.

Dicranomyia, sp.

A ♂ in the Indian Museum from Mormugao, Goa, ix-16 (*Kemp*) may represent a new species or an abnormality. It has the upper branch of the 4th longitudinal vein simple, the lower branch forked, and the discal cell coalescent with the 2nd posterior.

Dicranomyia pictipes, sp. nov.

♂ ♀. S. W. India. Long. $3\frac{1}{2}$ mm.

Head and appendages all black.

Thorax.—Dorsum cinnamon-brown with narrow median pale stripe from about the suture, carried uninterruptedly over scutellum and metanotum to basal segments of abdomen. Lower part of thorax all white, except a large oval black spot on the sternopleura.

Abdomen blackish-brown, a narrow median pale stripe of irregular length on basal segments. Belly yellowish, emarginations of segments blackish, genitalia black.

Legs.—Coxae white ; femora brownish-yellow, tips very narrowly blackish ; tibiae and tarsi snow-white to tips, former with two narrow dark brown rings placed just before the first and the second thirds of the length.

Wings grey, iridescent, veins very distinct, venation normal. Discal cell absent ; anterior branch of 4th vein forked, posterior branch simple. Anterior cross vein and posterior cross vein both in a line with the base of the open discal cell, which is coalescent with the 3rd posterior cell. Stigma rather large, dark brown, over marginal cross vein, sometimes elongated downwards as far as 1st posterior cell. A small suffusion over base of 2nd vein, sometimes continued narrowly along the cross

veins; posterior cross vein often narrowly suffused. Halteres obscurely yellowish with black clubs.

Described from a series (containing many immature examples) from Mormagao, Goa, ix-16 (*Kemp*).

A very striking species easily recognised from all others by the snow-white tibiae with the two narrow dark rings. It seems related to the snowwhite-legged species forming the *Thrypticomyia* group, but the cells are not crowded towards the wing tip as in Skuse's genus.

GERANOMYIA, Hal.

flavicosta, Brun., *Fauna Brit. Ind.* (1912), p. 389 ♀. Ganges Delta.

circipunctata, *id.*, *loc. cit.*, p. 390 ♂ ♀. Bengal (various localities); Madras.

tridens, *id.*, *loc. cit.*, p. 391 ♂ ♀. Ganges Delta.

pulchripennis, *id.*, *loc. cit.*, p. 393 ♀. Kurseong.

Types of the above species in Indian Museum.

notatipennis, Brun., *Rec. Ind. Mus.* VIII, p. 152 ♂ (1913). N. E. Assam. The unique type in the Indian Museum.

10-guttata, de Meij., *Tijd. v. Ent.* LVI, p. 345 ♂ ♀ (1913). Java. Types in Amsterdam Museum.

brunnescens, de Meij., *loc. cit.*, LVIII, Supp. p. 10 ♂, 1915 (1916). Sumatra. Unique type in Amsterdam Museum.

7-notata, Edw., *Ann. Mag. Nat. Hist.* (8) XVIII, p. 246 ♀ (1916). Arisan, Formosa, 8,000 ft., 10-x-12 (*I. Nitobe*). Unique type in British Museum.

linearis, Alex., *Proc. U. S. Nat. Mus.* XLIX, p. 163 ♂ (1916). Java.

javanica, *id.*, *loc. cit.*, p. 164 ♀. Java.

cornigera, *id.*, *Ins. Menstr.* I, p. 137. Pettit Barracks, Luzon, Phillippine Is. (*Ludlow*).

Geranomyia genitalis, Brun.

Two ♂ ♂ from the Pashok Spur, Darjiling District, 2,000—3,500 ft., 23-iv—11-v-15 (*Gravely*). These cannot satisfactorily be separated from typical specimens except that they appear less robust, the legs thinner and the wings clearer.

Geranomyia nigronotata, sp. nov.

♀. Malabar district, Madras Presidency. Long. $4\frac{1}{2}$ mm.

Head blackish, frons with greyish reflections; antennae brownish-yellow, with grey pubescence; proboscis and palpi blackish-brown.

Thorax.—Dorsum bright chestnut-brown, blackish on middle of anterior margin; a rather large round dead black spot in front of each wing-base; the posterior calli large, rounded, shining black. Scutellum and just behind wing base brownish yellow. Sides of thorax (except the brownish yellow sternopleurae), and metanotum with bluish-grey reflections.

Abdomen dark brown, belly a little more reddish ; ovipositor brownish yellow.

Legs yellowish, tips of femora and tarsi barely darker.

Wings very pale grey ; stigma oval, small, darker grey ; halteres brownish.

Described from a unique ♀ from the Pusa collection, Cherambadi, Wynaad, x-13 (*Howlett*) "in jungle." Type presented to the British Museum by Mr. T. B. Fletcher. The species is easily recognised by its clear wings (except for the grey stigma) and the black spots on the thorax.

Geranomyia flaviventris, sp. nov.

(Plate. vii, fig. 2.)

♂. Darjiling. Long. $4\frac{1}{2}$—5 mm.

Head blackish-grey ; antennae and proboscis black ; palpi placed at about middle of latter, which is about as long as the head and thorax together.

Thorax brownish-yellow on dorsum, with three longitudinal blackish stripes. At the suture the median one becomes very narrow, but continues more broadly over scutellum and metanotum. The outer stripes broaden behind the suture into a pair of large dark spots. Lower part of thorax dull brownish-yellow ; hinder part of pleurae and the metanotum wholly blackish-grey.

Abdomen black with short pubescence ; belly rather bright yellow ; genitalia conspicuous, 2nd joint of claspers of considerable length.

Legs blackish, coxae and more or less of the femora yellowish.

Wings pale grey with darker grey spots, a larger one over stigma, its centre extending downwards into the submarginal cell ; three smaller elongate ones placed transversely occur along the costa anterior to the larger stigmatic spot ; these are approximately equidistant, and extend more or less into the 1st and 2nd basal cells and submarginal cell. A similar spot over tip of 2nd longitudinal vein ; the "cross veins" in one specimen are just perceptibly suffused ; a small grey spot at tip of 7th vein. All these spots apparently variable in size and intensity. Halteres black, stems yellowish at base.

Described from three ♂ ♂ in the Indian Museum from Pashok, Darjiling District, 3,000 ft., 14-vi-16 (*Gravely*).

The general appearance of this species is very like *tridens*.

GERANOMYIA Halid. and **APOROSA,** Macq.

Kertesz gives the latter as synonymous with the former in his catalogue, and Speiser has doubted their distinctness, but Bergroth points out that the true distinction is the position of the palpi, placed far from the tip of the proboscis in *Geranomyia*, and close to the tip in *Aporosa*. Upon re-examining all my oriental species of *Geranomyia* they prove to truly belong to that genus, the palpi in all of them being placed at about the middle of the proboscis. The latter is about as long as the head and thorax together in all the species except *circipunctata*, in which it is barely half that length.

Aporosa aurantia, sp. nov.

♀. Assam. Long. 9 mm. to tip of ovipositor.

Body wholly bright orange. 2nd scapal joint of antennae, flagellum and proboscis black, latter nearly as long as whole body, palpi at its extreme tip very minute. A few isolated black hairs on occiput. Flagellum of antennae with long verticils. A barely perceptible darkening of hind border of abdominal segments, and traces of a narrow dark line on extreme side edge of tergites. Halteres and legs, including basal two-thirds of metatarsi, black; rest of tarsi white, tip of 4th joint and the 5th joint a little brown.

Wings very pale yellowish-grey; stigma elongate, small, indistinct, brown; venation normal, except that the 2nd vein takes a sudden bend upwards immediately before origin of 3rd vein.

Described from four ♀♀ in the Indian Museum from above Tura, Garo Hills, 3,500—3,900 ft., vii-17 (*Kemp*).

LIMNOBIA, Mg.

My Fauna volume (1912) contains the following new species: *festiva*, p. 400 ♂, Kurseong; *tinctinervis*, p. 401 ♀, Darjiling; *indica*, p. 401 ♂♀, Bengal (various localities); *trimaculata*, p. 402 ♂♀, Kurseong; *longinervis*, p. 403 ♀, Kurseong; *centralis*, p. 403 ♂♀, Kurseong; *niveipes*, p. 404 ♀, Darjiling; *nigra*, p. 404 ♂♀, Travancore; *vitripennis*, p. 405 ♀, Darjiling; *triangularis*, p. 406 ♀, Simla.

Types of all these in Indian Museum.

annulifemur, de Meij., *Tijd. v. Ent.*, LVI, p. 344 ♂ (1913). Java. The unique type in Amsterdam Museum.

crocea, Edw., *Ann. Mag. Nat. Hist.* (8), XVII, p. 353 ♂♀ (1916). Sungkei, Perak, 9-ii-02 (*Robinson* and *Annandale*). Types in British Museum.

nitobei, *id.*, *loc. cit.*, (8) XVIII, p. 247 ♂, pl. xii, 2, genitalia tip (1916). Arisan, Formosa, 8,000 ft., 10-x-12 (*I. Nitobe*). Unique type in British Museum.

Limnobia festiva, Brun.

The auxiliary vein ends distinctly though not greatly beyond the origin of the 2nd longitudinal vein, and not opposite to it as stated in my description.

Limnobia cinctiventris, Brun.

This was erroneously described as a *Dicranomyia*. *Limnobia vitripennis*, Brun. is synonymous.

Limnobia flavocincta, sp. nov.

♀. W. India. Long. 5 mm.

Closely allied to *cinctiventris* but with hind margins of upper side of each abdominal segment broadly yellow, the whole belly being yellow in one specimen, the basal part of some of the segments being black in the type. Upper part of dorsum shining blackish-brown with a pale

median space, which with the rather paler transverse suture divide this part apparently into four subequal shining dark spaces when viewed from above. Two fine, well separated black lines run from the anterior dark spaces nearly to the front margin Humeri yellowish. Scutellum yellowish, metanotum shining blackish-brown, the middle third yellowish. Tarsi yellowish-white, except about basal two-thirds of metatarsi.

Described from two ♀♀ in the Indian Museum from Mahabaleshwar, Satara District, 4,200 ft., 13—16-iv-12 (*Gravely*).

Limnobia marginata, sp. nov.

(Plate viii, fig. 7.)

♀. Assam. Long. 8 mm. to tip of ovipositor.

Body brownish-yellow; 1st scapal joint, proboscis, palpi and upper part of occiput and neck black or blackish. A large shining black spot at base of each abdominal segment, narrowed behind and reaching hind margin so that all the spots are united into a more or less angulated dorsal stripe, variable in extent, as in one specimen the black colour fills nearly all the surface and in another the spots are barely connected. Ovipositor rather large, brownish on upper side and basal section of lower valves. Femora yellowish, a broad black apical ring; tibiae dull brown; tarsi black.

Wings pale grey; costal and subcostal cells black, the colour carried round costa into submarginal cell at about which point it dies away. A black spot over origin of 2nd vein, over marginal cross vein and divergence of 2nd and 3rd veins, from which spot a narrow dark streak runs along the "cross veins" ending at tip of 5th vein in hind margin of wing. Halteres yellowish.

Described from five ♂♂ in the Indian Museum from above Tura, Garo Hills, Assam, 3,500—3,900 ft., vii-vii-17 (*Kemp*).

The very conspicuous costal black band should easily identify this species from all except *costalis*, W., and this latter species has a median dark line on the thorax and the legs all yellow.

Limnobia confinis, sp. nov.

♂♀. Assam. Long. 9 mm.

Very near *indica*, Brun. in general appearance but much larger and more robust. No dorsal black stripe on thorax. Dorsum of abdomen blackish-brown. Femora yellow, with moderately broad black apical ring; tibiae dull brownish-yellow; tarsi black. Wing much as in *indica*; auxiliary vein ending much before base of 3rd vein and distinctly before half way between base of 2nd vein and marginal cross vein. In *indica* the auxiliary vein ends distinctly *beyond* base of 3rd vein and a little beyond half way between base of 2nd vein and marginal cross vein. This difference in the two species is very constant. There is no suffusion over base of 2nd vein or only perceptible under close examination, but in *indica* there is an obvious though small suffusion at this spot.

Described from four of each sex from above Tura, Garo Hills, Assam, 3,500—3,900 ft., vii-viii-17 (*Kemp*). In Indian Museum.

Limnobia bipunctata, sp. nov.

♂. Assam. Long. about $5\frac{1}{3}$ mm.

Head dark grey; proboscis, palpi and antennae dark brown; latter with scape a little paler; flagellum with whitish pubescence.

Thorax wholly brownish-yellow, except dorsum, scutellum and metanotum which are shining black.

Abdomen moderately shining black; traces of pale hind margins to some of the middle segments, visible sometimes only towards the sides. Belly blackish-grey, hind margins and sides of segments paler. Genitalia rather large and complex.

Legs blackish-brown; femora yellowish with moderately broad blackish apical ring.

Wings pale grey, very shining; a rather large dark brown spot over base of 2nd vein and another over the stigma; a narrow dark streak from latter along the "cross veins" including outer side of discal cell. Auxiliary vein ending nearly half way between base of 2nd vein and marginal cross vein; 3rd posterior cell and discal cell subequal in length; 2nd posterior cell a little longer. Anterior and posterior cross veins at base of discal cell; submarginal cell very little longer than 1st posterior.

Described from three ♂ ♂ in the Indian Museum from above Tura, Garo Hills, 3,500—3,900 ft., vii-viii-17 (*Kemp*).

Limnobia tritincta, sp. nov.

(Plate viii, fig. 9.)

♂ ♀. Assam. Long. 5 mm.

Head blackish-grey; antennae slightly more yellowish.

Thorax brownish-yellow; a distinct but not clearly outlined median brownish dorsal stripe; the post-sutural swellings, scutellum and metanotum obscurely brown.

Abdomen blackish, paler at base; hind margins of segments broadly paler, also tip of abdomen; belly much as upper side. Genitalia in ♂ dark brown, of moderate size; in ♀ moderately short brown.

Legs pale yellowish; tarsi brown.

Wings very pale grey, long, with cells in distal part very elongated, *Libnotes*-like. As the 2nd vein originates in its usual course and the 2nd and 3rd posterior cells are equal in length it belongs to *Limnobia*.[1] Auxiliary vein ending half way between base of 2nd vein and marginal cross vein; endings of 2nd, 3rd and 4th veins practically parallel; anterior cross vein at base of discal cell, nearly in a line with base of 3rd vein; 2nd and 3rd posterior cells from $1\frac{1}{2}$ to $1\frac{3}{4}$ times as long as discal cell; posterior cross vein at middle of discal cell. A very small brownish

[1] See note on venation under *Libnotes*, p. 294.

suffusion over base of 2nd vein, tip of auxiliary vein and marginal cross vein. Halteres dark.

Described from a pair *in cop*, another ♂ and three other ♀♀ from above Tura, Garo Hills, 3,500—3,900 ft., vii-viii-17 (*Kemp*). In Indian Museum.

Limnobia 5-notata, sp. nov.

(Plate viii, fig. 8.)

♂. Assam. Long. 5 mm.

Head blackish-grey; antennae greyish-brown with pale pubescence.

Thorax yellowish-brown, with three narrow median stripes from anterior margin to suture, the outer ones thereat continued round the post-sutural swellings; side margins of dorsum also narrowly margined. Scutellum and metanotum brownish-grey.

Abdomen dull greyish brown; genitalia blackish, the inner parts pale yellow.

Legs obscure brown.

Wings pale grey. Five small brown spots over base of 2nd vein, tip of auxiliary vein, marginal cross vein, tip of 2nd vein, and base of 3rd vein. Anterior cross vein, inner and outer sides of discal cell and posterior cross vein very narrowly suffused. Auxiliary vein ending half way between base of 2nd vein and marginal cross vein, latter quite perpendicular, placed a considerable distance before tip of 2nd vein. Anterior cross vein distinctly beyond bases of both 3rd vein and discal cell; 2nd posterior cell shorter than discal cell; 3rd posterior cell much longer than 2nd by encroaching on discal cell; posterior cross vein at base of discal cell or just beyond. Halteres black.

Described from one ♂ in the Indian Museum from above Tura, Garo Hills, 3,500—3,900 ft., viii-17 (*Kemp*).

Limnobia longipennis, sp. nov.

♂. Assam. Long. 8 mm.

Head.—Eyes practically contiguous above for a considerable distance; frons blackish; proboscis pale dirty yellowish; palpi black; antennae dull dark brown; occiput grey, with long hairs.

Thorax brownish-yellowish.

Abdomen yellowish, a blackish band at base of each segment, narrowed towards sides; belly similar. Genitalia of moderate size, brownish yellow, black-haired; a large square ventral plate; a pair of brownish yellow horny cylindrical appendages just above it; 1st joint of claspers with a finger-like prolongation on inner side.

Legs.—Femora brownish-yellow with subapical black, not very well defined ring; remainder of legs black.

Wings yellowish-grey, very long, tip of genitalia barely reaching base of discal cell; auxiliary vein ending half way between base of 2nd vein and marginal cross vein; submarginal cell distinctly longer than 1st posterior cell; anterior cross vein, base of discal cell and posterior cross vein almost in a line; 2nd and 3rd posterior cells and discal cell subequally long. Small but obvious dark suffusions placed as follows:

at base of 2nd vein, tip of auxiliary vein, marginal cross vein, with a narrow streak from base of 3rd vein along anterior cross vein, base of discal cell and posterior cross vein. Halteres black.

Described from a ♂ in the Indian Museum from above Tura, Garo Hills, 3,500—3,900 ft., vii-17 (*Kemp*).

This species is near my *longinervis,* in which the wings are equally long, but in that species the cells in the apical third of the wing are extremely elongated, almost as much so as in *Libnotes.* When the two species are placed side by side their distinctness is obvious at a glance.

Limnobia nigrescens, sp. nov.

♂. Assam. Long. about 4½ mm.

Wholly dull black. Wings dark grey; auxiliary vein ending half way between base of 2nd vein and marginal cross vein, which latter is at tip of 2nd vein; anterior cross vein at base of discal cell, distinctly beyond base of 3rd vein; 2nd and 3rd posterior cells subequal, a little longer than discal cell; posterior cross vein a little beyond base of discal cell. Halteres black.

Described from three ♂ ♂ in Indian Museum from above Tura, Garo Hills, 3,500—3,900 ft., vii-viii-17 (*Kemp*).

This must be near *aterrima,* Walk. but in that species the antennae are described as setaceous and the wings are said to be black. In *nigrescens* the antennal joints are very distinct. There is also apparently a discrepancy in the venation as the figure Walker refers to shows the 2nd vein forked, in which case *aterrima* cannot be a *Limnobia.*

Limnobia punctithorax, sp. nov.

♂. S. W. India. Long. 5 mm.

Head brownish-yellow; eyes nearly contiguous above; antennae dark brown except the long 1st scapal joint brownish-yellow, the 2nd scapal joint being similar to the 1st flagellar.

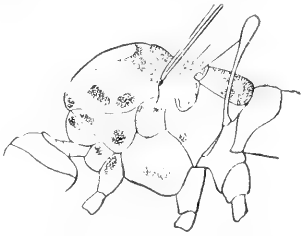

FIG. 1.—Thorax of *Limnobia punct thorax,* sp. nov., side view

Thorax rather elongate, brownish-yellow; pleurae pale yellowish; two rather large approximately oval blackish spots behind suture; scutellum blackish with a median pale stripe; metanotum blackish. A conspicuous feature of this species is the presence of a number of small more or less round black spots on the anterior and lower part of the thorax, situated as follows. Two, almost contiguous, on anterior margin; a row of four lower ones along prothorax; one in the small pit

behind the shoulder, another rather behind and below it; three above front coxae; one each on pteropleura and sternopleura.

Abdomen brownish-yellow, basal half of all segments blackish-brown.

Legs brownish-yellow, tarsi tips slightly darker.

Wings pale grey, stigma small, over marginal cross vein.

Described from a single ♂ in the Indian Museum from Talewadi, near Castle Rock, N. Kanara District, 9—10-x-16 (*Kemp*).

The conspicuous spots on the anterior part of the thorax distinguishes this species from all others.

RHIPIDIA, Mg.

Ceratostephanus, Brun., *Rec. Ind. Mus.* VI, 271 (1911).

This synonymy is evident, and I cannot understand how I came to overlook Meigen's genus.

My *C. antennatus* therefore comes here. Alexander would also sink my *Atypophthalmus* in *Rhipidia*, but it is certainly distinct as the antennae are normally constituted, without the appendages as in *Rhipidia*.

bioculata, de Meij., *Tijd. v. Ent.* LVIII, Supp. 11, 1915 ♂ (1916). Sumatra.

rostrifera, Edw., *Ann. Mag. Nat. Hist.* (8) XVII, p. 352 ♂ (1916). Kedah Peak, 3,200 ft., Malay Peninsula (*Dr. Stanton*). The unique type in the British Museum.

DAPANOPTERA, Walk.

Genotype: *D. perdecora*, Walk. by present designation.

lorentzi, de Meij., *Nova Guin. Res.* IX, p. 307 ♂ ♀ (1913).
fascipennis, *id.*, *l. c.*, p. 307, ♂ (1913).
pallida, *id.*, *l. c.*, p. 307 ♂ (1913).

Types of these in Amsterdam Museum.

pulchra, de Meij., *Tijd. v. Ent.* LVIII, p. 103 ♂ (1915). North Papua.

LIBNOTES, Westw.

This genus is simply a *Limnobia* with the distal cells conspicuously elongated, but two other venational characters appear to be tolerably constant. The 2nd vein originates not in the usual curve as in *Limnobia* but is straight in its basal section, and the base of the submarginal cell is in the same straight line, and at the origin of the 3rd vein the 2nd turns very sharply upwards at an acute angle. The other character is that the 2nd posterior cell is generally considerably longer than the 3rd by encroaching extensively on the upper outer corner of the discal cell. Osten Sacken, however, mentions seven species in which this is not the case.

Both *L. thwaitesiana*, Westw. and *L. poeciloptera*, Meij. were inadvertently omitted from my "*Fauna*" volume. The former has been taken in Calcutta, 5-viii-08 (*Annandale*) and at Peradeniya, Ceylon,

13 and 17-vii-10 (*Gravely*) and x-xi-1911 (*F. Edwards*). The latter species has been taken by Mr. E. E. Green also at Pundaluoya. *L. punctipennis* also occurs in Darjiling, Ceylon and Assam.

fuscinervis, Brun., *Fauna Brit. Ind. Dipt.*, p. 411 ♂ (1912). Darjiling.

notatinervis, *id.*, *loc. cit.*, p. 412 ♀ (1912). Darjiling.

Types of both species in Indian Museum.

affinis, de Meij., *Nova Guin. Res.* IX, p. 308 ♀ (1913). Papua. Unique type in (?) Amsterdam Museum.

punctatissima, de Meij., *Tijd. v. Ent.* LVIII, p. 102 ♂ (1915). North Papua. Unique type in Amsterdam Museum.

scutellata, Edw., *Ann. Mag. Nat. Hist.* (8), XVIII, p. 353 ♂ ♀, fig. 2, p. 356, genitalia (1916). Talum, Perak, 18-i-02 (*Robinson* and *Annandale*). *Types* in British Museum.

stantoni, *id.*, *loc. cit.*, p. 354 ♀; **limpida,** *id.*, *loc. cit.*, p. 355 ♀; **lutea,** *id.*, *loc. cit.*, p. 357 ♀.

All these three species taken by Dr. Stanton at Kedah Peak, 3,200 ft., Malay Peninsula; the unique types in the British Museum.

regalis, *id.*, *loc. cit.*, (8) XVIII, p. 248 (1912). Taihoku, Formosa, a unique much damaged specimen. In the British Museum.

transversalis, de Meij., *Tijd. v. Ent.* LIX, p. 198 ♂ (1916). Gedah, Java, 1,625—2,400 metres, May (*Konigsberger*). Type in (?) Amsterdam Museum.

montivagans, Alex., *Proc. U. S. Nat. Mus.* XLIX, p. 166 ♂ ♀ (1916).

nigricornis, *id.*, *loc. cit.*, p. 166 ♂ ♀.

opaca, Bezzi, *Phil. Jour. Sci.* XII, Sect. D, p. 116 ♂ (1917). Luzon (*Baker*).

marginalis, *id.*, *loc. cit.*, p. 116 ♂ (1917). Luzon (*Baker*).

Libnotes fuscinervis, Brun.

I am uncertain as to the limits of this species, which seems variable in the presence or absence of the additional cross vein and in the wing markings. In one specimen from Cochin State the veins are not at all suffused but the bases of all the cells, with the marginal and posterior cross veins, are very distinct in comparison with the rest of the veins, and these "cross veins" are similarly deeply outlined (though not thickened) in specimens which possess the suffusions. The short sections towards the tips of some of the veins which are also deeply outlined in normal forms are the same in the Cochin specimen. An example from the Garo Hills recently collected by Mr. Kemp has the additional cross vein and the exact suffusions of the normal form but all the legs are wholly black, whilst another from the same source has normal legs, and no additional cross vein nor trace of suffusions but all the veins deeply and uniformly outlined.

Section *RHAMPHIDINI.*

RHAMPHIDIA, Mg.

Three new species described in my Fauna volume (1912): *ferruginosa*, p. 418 ♂, Dawna Hills; *unicolor*, p. 419 ♂, Darjiling; *inconspicua*,

p. 419 ♂, Kurseong. All described from unique types in the Indian Museum, but further specimens of *ferruginosa* have been obtained.

kampangani, de Meij., *Tijd. v. Ent.* LVI, p. 346, (1913). Java.

apicalis, Alex., *Proc. U. S. Nat. Mus.* XLIX, p. 167 ♂ ♀ (1916). Java. Types in U. S. Museum.

nigriceps, Edw., *Ann. Mag. Nat. Hist.* (8) XVII, p. 358 ♂ ♀ (1916). Siam.

rufescens, *id., loc. cit.*, p. 358 ♀. Selangor.

Types of these two species in the British Museum.

Rhamphidia unicolor, Brun.

In this species the auxiliary vein ends distinctly in the 1st longitudinal.

Rhamphidia fratella, sp. nov.

Considerably like *ferruginosa,* Brun., but a smaller and more delicate species. The abdomen is blacker as are also the femora; the tarsi nearly whitish. The veinlet between the 2nd and 4th posterior cells three or four times as long as the discal cell instead of only about twice as long as in *ferruginosa.* Discal cell relatively much smaller; posterior cross vein more proximal, generally just before base of discal cell, though its position is not quite constant in either species.

Extreme length from frons to tip of genitalia, ♂ 4 mm.; ♀ to tip of ovipositor $5\frac{1}{2}$ mm.

Described from 2 ♂ ♂ and 2 ♀ ♀ from Castle Rock, N. Kanara District, 11—26-x-16 (*Kemp*). In the Indian Museum.

Rhamphidia abnormalis, sp. nov.

(Plate vii, fig. 3.)

♀. Assam. Long. $4\frac{1}{2}$ mm.

Head mainly brownish-yellow, tip of the proboscis, the palpi and antennae brown; latter with long pale verticils; basal joints of flagellum not incrassated; scape less conspicuously enlarged than in the other Indian species.

Thorax and *abdomen* brownish-yellow, dorsum of former a little darker, both with sparse pale pubescence.

Legs long: coxae brownish-yellow; femora and tibiae rather dark brown, former paler at base and narrowly snow-white at tips; latter broadly snow-white at tips; tarsi shorter than tibiae, snow-white, becoming yellowish at tips; metatarsus twice as long as rest of tarsus.

Wings clear, highly iridescent. *3rd vein originating some distance beyond anterior cross vein,* the latter uniting 2nd vein with discal cell. Auxiliary vein ending in costa opposite basal end of discal cell; subcostal cross vein at its tip; posterior cross vein at middle of discal cell. Halteres brownish-yellow, clubs darker.

Described from one ♀ in the Indian Museum. Cherrapunji, Assam, 4,400 ft., 2-3-x-14 (*Kemp*).

The abnormality in this species consists of the peculiarly late origin of the 3rd vein, and the consequent connecting of the 2nd

vein with the discal cell by means of the anterior cross-vein, a singularity occurring with extreme rarity in Tipulidae, and normally in only one oriental genus, *Amalopis.* It is by no means certain that a new genus should not be set up for the present species.

EURHAMPHIDIA, Alex., subgen. nov.

Proc. U. S. Nat. Mus. XLIX, p. 168.

A new subgenus of *Rhamphidia,* with *Rhamphidia niveitarsis,* Skuse as type. Alexander records the species (*loc. cit.*) from two places of high altitude in Java.

RHAMPHOLIMNOBIA, Alex., gen. nov.

Proc. U. S. Nat. Mus. XLIX, p. 169.

Near *Elephantomyia*; type species *R. reticularis,* sp. nov., *loc. cit.,* p. 169 ♀, Java. Type in the U. S. Museum.

The **Elephantomyia** group.

The two or three genera with enormously produced rostrums, up to nearly or quite as long as the body, may be considered separately from the rest of the sub-family though they do not necessarily form a separate group. Though they possess this character in common they vary in important other characters, in the presence or absence of the submarginal cell, and in the number of the antennal joints. The genera concerned are *Toxorhina,* Loew; *Elephantomyia,* Os. Sac.; *Limnobiorhynchus,* Westw., and a new genus *Conithorax.*

Whether the two first are synonymous I have no means of determining but it seems probable, judging from Osten Sacken's remarks in his Monograph of the North American Tipulidae, since he referred Loew's three fossil species of *Toxorhina* to his own genus *Elephantomyia.* In the event of synonymity, *Toxorhina* takes precedence. The exact application of the name *Toxorhina* is discussed further on.

If the claim of *Toxorhina* to stand for the fossil species be admitted there remains the question of a name for *fragilis* and its allies, and Bergroth would resuscitate *Limnobiorhynchus,* Westw. for these. The justness of this seems obvious, although the name is applicable only to the ♀ of Westwood's genotype *brasiliensis* for which latter a new specific name will now be required, since the name *brasiliensis* must be retained for the ♂, now referred to *Geranomyia.* I therefore propose *westwoodi* for the ♀ of Westwood's *brasiliensis,* and it will of course be the type species of *Limnobiorhynchus.*

The respective characters of the genera in question may be tabulated thus :—

A. Submarginal cell absent. (Antennae 12-jointed; long hairs on last two joints only; pronotum distinctly produced over neck; submarginal cell *absent*; posterior cross vein at base of discal cell; 6th vein very close to 5th for basal third of its length) *Limnobiorhynchus,* Westw.

AA. Submarginal cell present.

B. Antennae 12-jointed. (Antennae 12-jointed; long hairs on last two joints only; pronotum produced over neck; submarginal cell *present*; posterior cross vein at base of discal cell; 6th vein very close to 5th for basal third of its length) . . . *Conithorax*, gen. nov.

BB. Antennae 15-jointed. (Antennae 15-jointed; verticils on all joints equally long; pronotum *not* produced over neck; submarginal cell *present*; posterior cross vein at *middle* of discal cell; 6th vein *not* lying close to 5th] . . . . *Elephantomyia*, Os. Sac. and *Toxorhina*, Loew.

LIMNOBIORHYNCHUS, Westw.

Ann. Soc. Ent. France IV, p. 683, ♀ only (1835).

Type: *L. westwoodi*, *nom. nov.* for *L. brasiliensis*, Westw. ♀ only.

Recognition of this genus having been given, according to the argument adduced under *Toxorhina*, the following species will fall in it.

westwoodi, *nom. nov.* (*L. brasiliensis*, Westw. ♀ only) from Brazil.
fragilis, Lw. (*Toxorhina id.*) from Porto Rico.
magna, Os. Sac. from North America (*Toxorhina id.*).
muliebris, Os. Sac. from North America (*Toxorhina id.*).
incerta, Brun. (*Toxorhina id.*) from India.

Loew's figure of *fragilis* (*Toxorhina id.*)[1] shews a conical production of the thorax over the neck, though to a less extent than in *Conithorax latifrons*. In Needham's figure of *muliebris*, Os. Sac. (*Toxorhina id.*) the auxiliary and 1st longitudinal veins are shewn united though Osten Sacken mentions the existence of both auxiliary vein and subcostal cross vein.

Limnobiorhynchus incertus, Brun.

(*Toxorhina incerta*, Brun.).

This is undoubtedly a *Limnobiorhynchus* although it does not possess every character of the genus, as the pronotum is not at all produced over the neck, and the posterior cross vein is at a little before the middle of the discal cell instead of being at its base. Only the two last antennal joints (not four, as stated in my description) bear very long verticils, the remaining joints having them very short. The discal cell is present in the right wing and open in the left; the course of the single vein between the 1st vein and upper branch of the 4th may be unscientifically described as composed of the praefurca and the 3rd vein, with the 2nd vein absent. In this it is an exact replica of "*Toxorhina*" (=*Limnobiorhynchus*) *muliebris*, Os. Sac. The auxiliary vein is present but almost coalescent with the 1st, though it is quite obvious at both base and tip, but it is impossible to decide whether the subcostal cross vein is present or not.

CONITHORAX, gen. nov.

Allied to *Limnobiorhynchus*, Westw. in the very elongated proboscis, about as long as the whole body, with palpi at tip; in the 12-jointed antennae with very long verticils on last two joints only, the other joints bearing very short ones; in the two or three basal joints of the flagellum being more or less united in the form of a cone; also in the

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[1] *Linn. Ent.* V, pl. ii, 17, full insect; 16, antenna; 18, wing; 22, head.

front part of the thorax being prominently produced over the neck, and in the posterior cross vein at the base of the discal cell and the 6th vein lying very close to the 5th for about one-third of its length. The radical difference is the presence of the submarginal cell ; the 2nd vein is short, turning into the costa at an angle of 45° just beyond tip of 1st vein : 3rd vein bisinuate, more or less parallel with upper branch of 4th vein. Auxiliary vein very close to 1st, ending in costa opposite origin of praefurca ; subcostal cross vein present, a little before tip of auxiliary vein. The eyes are distinctly or very widely separated on the frons, contiguous or distinctly separated below.

Type species : *C. latifrons*, sp. nov.

This genus is practically a *Limnobiorhynchus* with the submarginal cell present, or in other words it possesses the typical venation of the subfamily with the peculiar characteristics of *Limnobiorhynchus*, that is, the enormously prolonged rostrum about as long as the whole body, the conically produced thorax over the neck and the long verticils on the last two antennal joints only.

There are two species, distinguished by a great difference in the width of the frons, though they are obviously congeneric.

Eyes separated above by a very broad frons, about one-third the width of the head, with parallel sides ; contiguous on under side of head . . .	*latifrons*, sp. nov.
Eyes separated above by a comparatively narrow frons, about one-eighth the width of the head with very convex sides ; on under side separated by one-fifth the width of the head	*brevifrons*, sp. nov.

Conithorax latifrons, sp. nov.

♀. Malay States. Long. about $3\frac{1}{2}$ mm. along curve of body to tip of ovipositor.

Head.—Frons and face forming nearly one-third of head, with parallel sides, ash grey ; eyes contiguous on lower part of head ; antennae

FIG. 2.—*Conithorax latifrons*, sp. nov., antennae.

brownish, last two joints with a verticil of three long whitish hairs on

each, rest of flagellum with very short hairs ; proboscis black, as long as front femur, nearly as long as whole body.

Thorax greyish-brown, metanotum darker with a little grey dust.

Abdomen light brown, hinder half of segments distinctly darker ; ovipositor large, basal part dull yellowish ; valves long, shining brown.

Legs dull brown, femora subapically a little blackish ; extreme tips pale ; tarsi black.

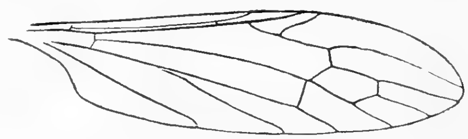

FIG. 3.—Wing of *Conithorax latifrons.*

Wings clear grey ; halteres yellowish.

Described from a unique ♀ in the Indian Museum from Bidai, Selangor-Pahang Boundary, Malay States, April 1917 (*C. Boden Kloss*).

Conithorax brevifrons, sp. nov.

♀. Assam. Long. 5 mm.

Head ash grey. Frons only one-eighth width of head, sides very convex ; eyes separated below by one-fifth width of head. Proboscis, palpi and antennae black or blackish-brown ; 1st scapal joint yellowish.

Thorax and *abdomen* dark brown ; pleurae and genitalia brownish-yellow. *Legs* dark brown, under side of femora a little paler. *Wings* with 2nd longitudinal vein a little less erect than in *latifrons*, ending more distally than anterior cross vein. In *latifrons* it ends before the cross vein. Posterior cross vein just beyond base of discal cell instead of just before it as in *latifrons*.

Described from a unique ♀ from above Tura, Garo Hills, Assam, 3,500—3,900 ft., viii-17 (*Kemp*). Type in Indian Museum.

ELEPHANTOMYIA, Os. Sac.

fuscomarginata, Ender., *Zool. Jahr.* XXXII, p. 64 ♂ (1912). Sumatra. Unique type in Stettin Zoological Museum.

egregia, de Meij., *Tijd. v. Ent.*, LVI, p. 347 ♂ (1913). Java. Unique type in Amsterdam Museum.

In both the above species the wings are figured as decidedly more cuneiform than in Osten Sacken's *E. westwoodi*, and the 3rd vein is in a line with the praefurca, the 2nd vein appearing to emerge from it at a considerable angle ; the auxiliary vein being shewn distinctly in *fuscomarginata* but not in *egregia*.

TOXORHINA, Loew.[1]

GENOTYPE : *T. longirostris*, Loew (fossil) by present designation.

The question as to which of two groups of species this name should apply dates back to 1868, originating with Schiner's objection to Osten Sacken's application of the name.

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[1] Spelt thus by Loew and Scudder. Osten Sacken and Kertesz emend to *Toxorrhina*, but Bergroth, the latest authority, reverts to the original spelling.

In preparing my " Fauna " volume I relied mainly on Osten Sacken's decision, one in which Kertesz apparently acquiesces in his catalogue of the World's Diptera, but Professor Bergroth's recent plea[1] for the retention of the name in Loew's original sense seemed so convincing that I have felt constrained to examine exhaustively the whole controversy afresh.

The argument briefly is as follows.

Loew in 1850[2] proposed the name *Toxorhina* for a genus (only characterised by its position in a table) of three fossil species which he named but did not describe. In 1851[3] he published a paper from which generic characters could be drawn up as applying to one or more of these three species, but gave no formal generic description alone. He also added to the genus a living species, *fragilis.*

Now Westwood in 1835 had set up *Limnobiorhynchus*[4] for *brasiliensis*, sp. nov. ♂ ♀ and *canadensis*, sp. nov. ♂. In 1859, Osten Sacken took what he thought to be *canadensis* in considerable numbers at Trenton Falls, New York, and ascertaining it could not be congeneric with *brasiliensis*, judging by the description of the latter, he set up a new genus for it, *Elephantomyia.*[5]

Later on, Osten Sacken wrote a further paper on North American *Tipulidae*[6] where he characterised *Toxorhina*, on Loew's living species *fragilis*, adding two new ones from North America. Schiner objected[7] to the application of *Toxorhina* to *fragilis*, as he considered that Loew intended it primarily for his three fossil species. Osten Sacken in his Monograph of the North American Tipulidae[8] contests Schiner's objection at considerable length but rightfully enough states that the fossil species and *fragilis* cannot be congeneric. He also considers Loew's " generic description "[9] to apply almost entirely to *fragilis*, as the fossil species possess a submarginal cell, which latter is absent in *fragilis.*

By this time he had inspected the types (♂ ♀) of *L. brasiliensis* in Westwood's own cabinet and found that they represented different genera, the ♂ being a *Geranomyia*, the ♀ belonging to what Osten Sacken called *Toxorhina*, that is to say, the group comprising *fragilis* and which is to-day without a name.

The antennae in the three fossil species have fifteen joints, in *fragilis* twelve only, Loew concluding therefore that in his living species, of which he had several specimens, the last three joints had been broken off. On the strength of these two important characters Osten Sacken again

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1 *Ann. Mag. Nat. Hist.* (8) XI, p. 580 (1913).

2 " Bernstein v. Bernstein fauna " in *Prog. Konig. Realschule zu Meseritz*, p. 26 (Sept. 1850).

3 *Linn. Entom.* V, p. 400 (1851).

4 *Ann. Soc. Ent. France* IV, p. 683 (1835).

5 *Proc. Acad. Nat. Sci. Philad.* p. 220 (1859). Incidentally there is no positive means available to me of knowing whether this paper was actually published in 1859. It was read at the August meeting of 1859, and may have been published then, or the whole volume (which bears a printer's date of 1860) may have been published entire in 1860. It does not affect any question of synonymy.

6 *Proc. Ent. Soc. Philad.* p. 277 (1865). I have not been able to see this paper.

7 *Reise d. Novara*, p. 33 (1868).

8 *Monog. Dipt. N. Amer.* IV, in *Smith. Misc. Coll.* VIII, p. 112 (1869).

9 Referring presumably to the table of genera (1850) or the characters distributed amongst the four species (1851).

referred Loew's fossil species to his own genus *Elephantomyia* having also recognised his supposed *canadensis*, Westw. to be a different species from Westwood's, and calling it *westwoodi*, and he retained *Toxorhina* for *fragilis*, including in it his two North American species. Scudder, comparatively recently,[1] supports Schiner's view, and Kertesz in his "Katalog" follows Osten Sacken, but Bergroth has reopened the controversy and his view appears to be just.

A continual difficulty in this discussion is that opposite views may be held at almost every stage, leading naturally to exactly opposite final results. According to present day standards *Toxorhina* was at best but weakly characterised, but it must be remembered that in Loew's time very few Tipulidae with excessively long rostrums were known and it could in those days be easily recognised.

Secondly, it may certainly be claimed that as he at the erection of the generic name (1850) neither nominated a known species nor described any one of his three fossil ones the genus was simply a *nomen nudum*.

However, in his next paper (1851), though he still gives no purely generic description,[2] he sufficiently characterises the three fossil species (*longirostris*, *pulchella* and *brevipalpa*), and from these characters those of the genus can be gleaned. In this paper he adds a description of a living species, *fragilis*. He says nothing about a submarginal cell being present or absent in the fossil species; he figures the palpus of each fossil species, the tip of the proboscis of one (*longirostris*) and also figures *fragilis* (full insect, wing and other parts).

Osten Sacken contended that the generic characters apply wholly to *fragilis* [3] and therefore he retained the name *Toxorhina* in his monograph for it, *plus* his two American species, and relegated Loew's three fossil species to *Elephantomyia*, Os. Sac.

Now the whole tenor of Loew's writings on *Toxorhina* convinces me that he intended the name to apply mainly to the three fossil species, firstly because when he set up the genus he mentioned no others but them and secondly because all these are mentioned first in his descriptive paper (1851), *fragilis* being added in a succeeding paragraph as a new species. Osten Sacken also notes (Monog. p. 113) that Loew, speaking at a meeting of German naturalists at Konigsberg, mentioned having discovered a genus which he had called *Toxorhina* for three fossil species, continuing "afterwards I became acquainted with a living representative of the same genus." From the priority given to the fossil species both in his paper and his speech it is quite evident that Loew in his own mind regarded *Toxorhina as definitely established before the discovery of fragilis*, that is to say, established for his three fossil species.

Though Osten Sacken did not see the fossils themselves, he examined drawings of them lent him by Loew, and these drawings shew the presence of a submarginal cell, which cell is absent in *fragilis*.

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1 *Proc. Amer. Philos. Soc.* XXXII (1894). Reprinted as "Tertiary Tipulidae."

2 *Linn. Entomologica*, V, p. 400.

3 "This description applies to *T. fragilis* only and not to the three fossil species," (*Osten Sacken.*)

Fragilis, therefore, cannot be congeneric with the other species and Loew must have not only overlooked the presence of the submarginal cell in his fossil species but *must have necessarily been under the impression that it was absent*, from his observation that his genus was "remarkable . . . for the abnormal venation of its wings." Such an observation would quite apply to a fly in which he thought the submarginal cell was absent because such an instance was certainly remarkable, whereas at least one submarginal cell or two such cells are normally present in the great majority of Tipulidae. There is no other abnormality in the venation of *T. fragilis*, and it could only have been by some unaccountable oversight that Loew regarded his fossil species as possessing similar venation. Loew's own figure of *fragilis* clearly indicates that no submarginal cell is present in at least that species. It might, of course, be contended by those disposed to argue that even the drawings were incorrect, and the submarginal cell introduced inadvertently, in which case *fragilis* and the fossil species might venationally be congeneric, but the difference in both number and structure of the antennal joints in the two groups again effectually separates them generically.

It being thus obvious that *fragilis* could not be congeneric with the three fossil species, Osten Sacken adopted *Toxorhina* for the former, and relegated the latter to *Elephantomyia*, Os. Sac. with the species of which they possess other agreements than that of the venation only.

Their principal character in common is that of the antennae, which are 15-jointed in the living species of *Elephantomyia* and also in Loew's fossil species, bearing verticils on all the joints. In *fragilis* and the two new North American species that Osten Sacken included under his *Toxorhina* the antennae are 12-jointed only, and bear verticils on the last two joints only.

It may be as well to mention here an apparent discrepancy with regard to the palpal joints. Loew said that the last joint of the palpus was "not so long as, or scarcely longer than those which precede, taken together," and Scudder adopted that author's statement. Now, apart from whether the words "those which precede" mean only the two preceding joints or *all* the preceding joints (4), the last joint in all the three fossil species is figured as considerably shorter than even the preceding joint only.[1] There is evidently some oversight here that escaped Scudder, whilst Osten Sacken does not comment in his Monograph on the respective length of the joints, and his description of these organs when setting up his *Elephantomyia* shews they are therein very close to Loew's figures of his fossil species.

In conclusion, the argument adduced by Osten Sacken in favour of reserving *Toxorhina* for *fragilis* and its living North American allies does not appear sound, and if he hesitated to "differ from the eminent dipterologist," (Loew), I would also have experienced still more diffidence in disagreeing with Baron Osten Sacken were it not for Prof. Bergroth's recent concise statement of the case.

Toxorhina, in the present interpretation of the genus, is not oriental, and is confined to Loew's three fossil species unless it is proved that

[1] In Loew's figures of the palpi of his three fossil species two possess five joints and the third four joints only.

Elephantomyia is synonymous with it. As *longirostris* is the first noted species by Loew it may be taken as the type of the genus.

STYRINGOMYIA, Loew.

Pycnocrepis, Ender., *Zool. Jahr.* XXXII, p. 57 (1912) : synonymy by Alex., *Pr. U. S. Nat. Mus.* XLIV, p. 487 (1913).

GENOTYPE : *S. venusta*, Lw. (fossil, in copal) by original designation.

All the known species of this genus have been recently revised by Edwards.[1] In that paper he finds that in my description of what I afterwards took to be his *ceylonica* [2] (though it was drawn up a year or more before his description was published), two or more species are included. The description of *ceylonica*, therefore, both in my Fauna volume and elsewhere [3] must not be relied on. Mr. Edwards also notes that my *obscura* is a ♀, not a ♂ as stated.

He describes the following species [4] : *nigrofemorata*, p. 215 ♀, Taiping, Malay States; unique type in British Museum : *formosana*, 219 ♂ ♀, Formosa ; type in Deuts. Ent. Mus. Berlin ; paratypes in British Museum : *javana*, 220 ♂, Java ; *jacobsoni*, 220 ♂ ♀, Java ; types of the two latter species in Amsterdam Museum ; *fryeri*, 221 ♂♀, Peradeniya, Ceylon ; type in British Museum ; *himalayana*, 221 ♂ ♀, base of E. Himalayas ; *nepalensis*, 222 ♂ ♀, Nepal ; types of both species in Indian Museum.

Dr. Annandale, whilst touring the East, took a ♂ and ♀ *in côp* of *S. crassicosta*, Spies. (*ceylonica* Edw.) at Singgora, Siam, 27-i-16. Prof. Riedel has recorded this species from Formosa. *Pycnocrepis annulipes*, Ender. is synonymous.

A very interesting short paper by Edwards,[5] entitled " On the so-called new Tipulid subfamily Ceratocheilinae, Wesché," gives the relationship between *Styringomyia* and *Ceratocheilus*, and their difference from *Toxorhina* in Osten Sacken's sense of the latter, which I herein regard as *Elephantomyia*, Os. Sac.[6]

TEUCHOLABIS, Os. Sac.

Teucholabis fenestrata, Os. Sac.

This species shews considerable variation in the thickening of the femora tips, in the coloration of the wing, which is sometimes almost entirely pale brown, and in the shape of the second posterior cell, which is sometimes strongly petiolate. When these three characters vary in the same individual they almost give the impression of specific distinctness and there are three such specimens in the Indian Museum from Bhim Tal. These characters, however, vary individually.

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[1] *Trans. Ent. Soc.*, 1914, pp. 206-227.

[2] *Ceylonica* has subsequently been admitted by Edwards as synonymous with *S.* (*Idiophlebia*) *crassicosta*, Speiser.

[3] *Rec. Ind. Mus.* VI, p. 298.

[4] *Trans. Ent. Soc.*, 1914.

[5] *Ann. Mag. Nat. Hist.* (8) VIII, p. 279 (1911).

[6] See p. 303.

The dorsum of the thorax in two out of the three is nearly black, as it is sometimes in otherwise normal specimens. The species was common at Tura 1,200—1,500 ft. and above Tura 3,500—3,900 ft., Garo Hills, Assam, June to October 1917 (*Kemp*).

insignis, Brun., *Fauna Brit. Ind. Dipt.*, p. 430 ♂ (1912). Travancore. Unique type in Indian Museum.

biannulata, *id.*, *loc. cit.*, p. 430 ♂ (1912). Kurseong; N. E. Indian Frontier. Type in Indian Museum.

plecioides, de Meij., *Tijd. v. Ent.* LVI, p. 348 ♀ (1913).

glabripes, *id.*, *loc. cit.*, p. 349 ♂ (1912).

Both species from Java; the unique types in Amsterdam Museum.

femoratus, de Meij., *Tijd. v. Ent.* LVIII, Supp., p. 67 ♂, 1915 (1916). Sumatra.

nigerrima, Edw., *Ann. Mag. Nat. Hist.* (8) XVIII, p. 248, ♂ (1916). Horisha, Formosa, 10-v-13 (*Maki*); Taihoku, Formosa (*Shiraki*). Type in British Museum.

Teucholabis cyanea, Edw. is referred to my *Gymnastes.*

Teucholabis angusticapitis, sp. nov.

(Plate viii, fig. 11.)

♂. Assam. Long. 5 mm.

Head.—Neck very long, blackish; head narrow, elongate, occiput and frons on same level, bluish ash grey with a few short hairs; proboscis, palpi and antennae dark brown.

Thorax moderately dark shining brown, a little paler in front; pleurae with a suspicion of blue grey dust.

Abdomen dark brown, considerably dark pubescent; paler along median line: genitalia of moderate size, concolorous, shining.

Legs uniformly dark brown, conspicuously pubescent.

Wings pale blackish-grey, scarcely darker anteriorly; two narrow pale cross bands reaching nearly from anterior to posterior margins, the first just before tips of basal cells, the second contiguous to outer side of discal cell.

Described from a unique ♂ in the Indian Museum from above Tura, Garo Hills, 3,500—3,900 ft., viii-17 (*Kemp*).

Teucholabis ornata, sp. nov.

♂. Ceylon. Long. $6\frac{1}{2}$ mm.

Head shining black, set on a rather long neck; antennae black with a little pale pubescence.

Thorax.—Prothorax much developed anteriorly, dark shining brown, bare; mesothorax shining black, bare, with a tinge of shining brown behind the suture; metanotum shining black; pleurae blackish.

Abdomen black, with sparse short hairs and a little longer hair at the sides; hind part of 2nd and 3rd segments broadly reddish-brown, of the remaining segments more narrowly yellowish. Genitalia black with yellowish parts.

Legs.—Coxae reddish-brown ; femora and tibiae brownish-yellow, former broadly black at tips, latter more narrowly so ; tarsi brownish, darkening to black at tips. All legs with short pale pubescence.

Wings pale yellow, a yellowish-brown suffusion over tip of 1st vein, carried downwards along the cross-veins as far as the 5th longitudinal vein ; a similar small suffusion over base of 2nd vein. Costal cell yellowish ; halteres bright brownish-yellow.

Described from a unique ♂ in the Indian Museum from Peradeniya, Ceylon, 11-viii-10.

Teucholabis ornata, Brun., var. **assamensis,** nov.

This differs from the typical form from Ceylon simply by the wings being marked only by the deep black stigma with barely a suggestion of suffusion along the transverse veins. The femora are black for about their apical third and the tibiae and tarsi wholly black.

One ♂, Shillong, 5,500-6,400 ft., 29-viii—5-ix-15 (*Kemp*).

? **Teucholabis,** sp.

An interesting ♀ specimen in the Indian Museum from Parambikulam, Cochin State, 1,700—3,200 ft., 16—24-ix-14 (*Gravely*), presents the venation of this genus except that the submarginal cell is considerably longer than the 1st posterior. The antennae, apparently 16-jointed, differ from the *Teucholabis* form ; the basal joints of the flagellum are very indistinctly separated, and covered with minute pubescence which renders their separation more difficult ; the more distal ones are much longer and more easily defined. The legs (only one leg, a hind one, remains) are long and slender, much more so than is usual in this genus. The wings are yellowish, with numerous small brown marks, the thorax yellowish with two long median black stripes and two outer shorter ones ; the pleurae very dark brown with a narrow pale horizontal stripe along the middle. The abdomen is yellowish-brown ; the coxae nearly white ; the legs brownish-yellow, becoming white on the tarsi ; tips of hind femora white, with a narrow dark ring preceding it. Long. nearly 6 millim. to tip of ovipositor.

? **Teucholabis,** sp. nov.

A single damaged ♂ taken by Mr. Kemp at Castle Rock, N. Canara District, 11—26-x-16, shews the peculiarity of the 2nd longitudinal vein being forked just beyond the marginal vein, the fork ending in the costa just beyond the tip of the 1st longitudinal. It is a yellow species ; the thorax with a rather broad deep black median stripe and a black spot towards each side behind the suture ; the abdomen with the basal half of each segment black ; the antennae black except the scape ; the wings as in my *insignis*, with the difference that the costa is clear except from the stripe that extends over the cross veins to the tip of the wing, which is broadly suffused, as far basally as the distal side of the discal cell. The only two remaining legs (detached) are black, the femora slightly thickened towards tips and with a sub-apical yellow ring. Long. 6 mm.

GYMNASTES, Brun.

Alexander regards this genus as synonymous with *Teucholabis*, Os. Sac. One of the principal characters of my genus was the absence of a distinct neck, which in *Teucholabis* is obviously elongate as stated by its founder.

This is the case in the three oriental species of *Teucholabis* before me: *fenestrata*, Os. Sac., *insignis* and *biannulata*, mihi. Also, none of these species have any incrassation of the hind femora. The close approximation of the auxiliary vein to the 1st longitudinal seems a good character in *Gymnastes.* Alexander says some species of *Teucholabis* approach my genus in venation. However, Mr. Edwards has pointed out [1] a character which had escaped me and on which he thinks the genus can stand at least provisionally, *i.e.*, the presence of small scales covering the legs. My *G. violaceus* is synonymous with his *Teucholabis cyanea*, a species which may now be referred to *Gymnastes*, to which genus he also adds a new species and refers *Gnophomyia ornatipennis*, de Meij.[2] The species belonging to the genus now are as follows :

1. **cyanea,** Edw., *Ann. Mag. Nat. Hist.* (8) VIII, p. 61 (*Teucholabis*) July (1911).
   Gymnastes violaceus, Brun., *Rec. Ind. Mus.* VI, p. 282 (Dec. 1911). India.
2. **ornatipennis,** de Meij., *Tijd. v. Ent.* LIV, p. 47 (*Gnophomyia*), (1911). Java ; Formosa. Riedel records it from Formosa also.
3. **pictipennis,** Edw., *Ann. Mag. Nat. Hist.* (8) XVII, p. 358 ♂; fig. 4 (p. 356), genitalia (1916). Siam.
4. **bistriatipennis,** sp. nov. N. Canara.
5. **pennipes,** sp. nov. Assam.

Gymnastes bistriatipennis, sp. nov.

♂. S. W. India. Long. 3½—4 mm.

Head brownish-yellow, frons with a median blackish stripe and often a transverse one also ; palpi and antennae black, scape brownish-yellow.

Thorax.—Dorsum shining black ; shoulders broadly brownish-yellow, the colour extending more or less anteriorly and as far hindward as the transverse suture. Sides of thorax dull brownish-yellow with darker parts ; scutellum and metanotum black.

Abdomen dull black with short dark pubescence ; genitalia concolorous. The latter consist of a pair of conical dark brown, long-haired claspers somewhat attenuated towards tips, a large oblong slightly curved brownish-yellow ventral plate from the centre of the hinder margin of which projects a concolorous cylindrical style as long as the claspers.

Legs.—Ground colour brownish-yellow with very short black pubescence, but almost entirely covered with small black scales so that they

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[1] *Ann. Mag. Nat. Hist.* (8) XVII, p. 358 (1916).

[2] Edw., *Ann. Mag. Nat. Hist.* (8) XVIII, p. 249. Two ♀♀ from Arisan, Formosa 8,000 ft., 10-x 12 (*Nitobe*).

appear black or dark brown with a yellow (unscaled) subapical ring on all the femora, the latter more or less yellowish on basal half, due to the scales being less numerous or absent there. All the femora gradually thickened towards tip.

Wings moderately dark brown with two rather narrow pale transverse bands from costa to hind margin, dividing the wing into three subequal areas, base more or less pale; halteres black with pale yellow tips.

Described from a long series of ♂ ♂ only taken by Mr. Kemp at Talewadi, near Castle Rock, North Canara District, 3—10-x-16. *Type* and other specimens in Indian Museum; cotypes in my collection.

Gymnastes pennipes, sp. nov.

(Plate viii, fig. 10.)

♂. Assam. Long. $3\frac{1}{2}$ mm.

Head.—Frons very broad, more than $\frac{1}{3}$ width of head, shining violet blue; antennae, proboscis and palpi dark brown.

Thorax shining violet blue; pleurae slightly white dusted; a milk-white longitudinal stripe just below dorsum.

Abdomen shining violet blue; genitalia also apparently constructed as in *cyanea.*

Legs.—Coxae black; hind pair with a conspicuous oval white spot in front; femora moderately dark brown, the distinctly clubbed tips of hind pair broadly dark brown, preceded by a narrow bright yellow ring without clear edges. Anterior femora barely thickened at tips, the yellow ring very fajnt. Anterior tibiae and tarsi dark brown; hind tibiae brownish-yellow, nearly the apical half shining violet with conspicuous long stiff black pubescence. Hind metatarsus with basal half yellow, rest of tarsus black. Some scales towards tip on inner side of hind femora.

Wings as in *cyanea* but 2nd vein distinctly forked, the upper branch short, ending in costa just beyond tip of 1st vein. The apical transverse band very faint. Halteres black, tip of clubs milk-white.

Described from a single ♂ from above Tura, Garo Hills, 3,500—3,900 ft., vii-17 (*Kemp*).

ATARBA, Os. Sac.

flava, Brun., *Fauna Brit. Ind. Dipt.*, p. 435 ♂ ♀ (1912). Darjiling. Types in Indian Museum.

pallidicornis, Edw., *Ann. Mag. Nat. Hist.* (8) XVIII, p. 249, ♀ (1912). Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*). Unique type in British Museum.

fuscicornis, Edw., *l. c.*, p. 250, ♀, from same locality and collector. Unique type in British Museum.

javanica, Alex., *Proc. U. S. Nat. Mus.* XLIX, p. 171 ♀ (1916). Java. Type in the U. S. Museum.

Alexander says (*loc. cit.*) that *A. flava,* Brun. is the only other oriental species of the genus,[1] the remainder probably belonging to *Leiponeura*;

[1] That is to say, other than *javanica.*

these being *nebulosa*, *pilifera* and *diffusa* (all Meij. from Java), adding that *A. lamellaris*, Spies. from Africa is also an *Atarba*.

ORIMARGA, Os. Sac.

peregrina, Brun., *Fauna Brit. Ind. Dipt.*, p. 424 ♂ (1912). Kurseong. Pashok, Darjiling District, 3,500 ft., vi-16 (*L. C. Hartless*). *Type* in Indian Museum.

Two ♂ ♂ and 1 ♀ from hills near Taiping, Perak, taken by Dr. Annandale, 26—30-xii-15. My figure of this species ("Fauna," pl. viii, 11) is somewhat incorrect, as the auxiliary vein ends just beyond half way between the origin of the 2nd longitudinal vein and the marginal cross vein, as indeed is stated in my description.

The type specimen has darkened with age until it is now nearly black, but three ♂ ♂ from Ghumti, Darjiling District, viii-11 (*Gravely*) appear to be this species, agreeing well with the description.

javana, de Meij., *Tijd. v. Ent.* LVI, p. 348 ♀ (1913). Java. The unique type in the Amsterdam Museum.

ANTOCHA, Os. Sac.

indica, Brun., *Fauna Brit. Ind. Dipt.*, p. 426 ♂ ♀ (1912). N. India; Assam (var. locs.).

unilineata, *id.*, *loc. cit.*, p. 427 ♀ (1912). W. Himalayas. Types of both species in Indian Museum.

javanensis, Alex., *Proc. U. S. Nat. Mus.* XLIX, p. 171 ♀ (1916). Java. Type in the U. S. Museum.

Section *ERIOPTERINI.*

RHYPHOLOPHUS, Kol.

geniculatus, Brun., *Fauna Brit. Ind., Dipt.*, p. 441 ♂ (1912). Kurseong.

pulcher, *id.*, *loc. cit.*, p. 442 ♀ (1912). Simla; Kumaon. Types of both species in Indian Museum.

MOLOPHILUS, Curt.

inconspicua, Brun., *Fauna Brit. Ind. Dipt.*, p. 444 ♂ ♀ (1912). India (var. locs.).

assamensis, *id.*, *loc. cit.*, p. 445 ♂ (1912). Sylhet. Types of both species in Indian Museum.

costalis, Edw., *Ann. Mag. Nat. Hist.* (8) XVIII, p. 251 ♀ (1916). Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*). Unique type in British Museum.

ERIOPTERA, Mg.

My Fauna volume (1912) contains the following new species: *E. punctipennis*, p. 449 ♀, Kurseong; *ferruginea*, p. 450 ♂, Travancore; *distans*, p. 451 ♂, Kurseong; *incerta*, p. 452 ♂, Darjiling; *parallela*,

p. 453 ♀, Kurseong; *orientalis*, p. 453 ♂ ♀, Darjiling; *subtincta*, p. 455 ♂ ♀, Darjiling; *flava*, p. 455 ♂ ♀, Bengal (var. locs.); *grandior*, p. 456 ♀, Simla; *genitalis*, p. 456 ♂ ♀, Kumaon.

My *E. brevior* (*loc. cit.*, p. 452, ♂ ♀) must be referred to *Empeda* with my *Empeda inconspicua* (*loc. cit.* p. 475 ♂ ♀) as a synonym of it.

My *Erioptera halterata* (*loc. cit.*, p. 457 ♂ ♀) is synonymous with *flava*, the halteres varying in colour, and the 7th vein being equally sinuous in both forms.

Types of all in the Indian Museum, several species represented by uniques.

fusca, de Meij., *Tijd. v. Ent.* LVI, p. 351 (1913). Java.

nigripalpis, *id.*, *loc. cit.*, p. 351 ♂ ("♀" lapsus).

The unique types in Amsterdam Museum.

insignis, Edw., *Ann. Mag. Nat. Hist.* (8) XVIII, p. 251 ♂ ♀ (1916). Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*), also in the British Museum from Tokyo. *Type* in British Museum.

alboguttata, Edw., *loc. cit.*, p. 252 ♂ (1916). Arisan, Formosa, 10-x-12 (*Nitobe*). Unique type in British Museum.

ACYPHONA, Os. Sac.

GENOTYPE: *Erioptera venusta*, Os. Sac. by present designation.

fenestrata, de Meij., *Tijd. v. Ent.* LVI, p. 352 ♀ (1913). Java. The unique type in Amsterdam Museum.

MESOCYPHONA, Os. Sac.

GENOTYPE: *Erioptera caloptera*, Say, by personal designation. (Fauna, 1912).

nigripes, Brun., *Fauna Brit. Ind. Dipt.*, p. 458 ♂ (1912). Kurseong, Darjiling. Type in Indian Museum.

Mesocyphona gracilis, sp. nov.

♀. Assam-Bhutan Frontier. Long. 3 mm.

Head and *thorax* moderately dull blackish-brown, with slight whitish reflections; pleurae with a slightly pinkish brown tinge with whitish reflections; scutellum slightly yellowish.

Abdomen nut-brown, posterior margins slightly darker.

Legs.—Coxae pinkish-brown, remainder brownish-yellow, tarsi a little darker.

Wings clear, stigma barely perceptibly yellowish. Base of 3rd vein, anterior cross vein, base of (open) discal cell and posterior cross vein practically in a line. 1st submarginal and 2nd posterior cells subequal in length. Halteres dirty brown.

Described from a unique ♀ in the Indian Museum from Bhoirakund, Assam-Bhutan Frontier, Darrang District, 18—22-x-12 (*Kemp*).

A slender, graceful species compared with *nigropes*, Brun. the only other species known from India.

EMPEDA, Os. Sac.

My *Erioptera brevior* (*Fauna*, p. 452 ♂ ♀, 1912) is an *Empeda*, and my *Empeda inconspicua* (*loc. cit.*, p. 475 ♂♀) is identical. Both are from the Darjiling District and the types of both are in the Indian Museum. An additional specimen from Pashok, Darjiling District, 3,500 ft., vi-16 (*L. C. Hartless*).

Gonomyia antica, Brun. (*Fauna*, p. 568, 1912) is an *Empeda*, as pointed out by Bergroth. The relative positions of the tip of the auxiliary vein and origin of the 3rd vein vary in *Gonomyia*, *Empeda* and *Leiponeura*.

GONOMYIA, Mg.

In my Fauna volume (1912) the following new species are described: *incompleta*, p. 471 ♂ ♀, Bengal (var. locs.); E. Himalayas; *flavomarginata*, 472 ♂ ♀, Darjiling District; *affinis*, 472 ♂ ♀, Darjiling District; *aperta*, 473 ♂, Bengal; *proxima*, 474 ♂ ♀, Bengal and Nepalese Himalayas. Types of all the species in Indian Museum.

In the Appendix to the above volume (p. 568) is described *G. antica* from the Darjiling District, which is an *Empeda*. The demarcation of the dorsum from the sides of the thorax in *flavomarginata* seems to fade considerably after death. A better distinction between these two species than that given in the "Fauna" is as follows, but the relative position of the posterior cross vein must not be relied upon too closely.

Basal section of 3rd vein very short, even punctiform, at most one-fourth the length of the anterior cross vein. 1st posterior cell conspicuously narrowed at tip . *incompleta*.
Basal section of 3rd vein of considerable length, from one-half to nearly as long as anterior cross vein. 1st posterior cell only slightly narrowed at tip . . *flavomarginata*.

I am glad to see that Alexander does not remove from *Gonomyia* those species with only one submarginal cell. Some regard these as a separate genus (*Leiponeura*, Skuse) and would refer them to the Rhamphidini, and Bergroth would thus refer my *G. incompleta* and *flavomarginata*, but *Gonomyia* in the wide sense forms a natural group.

Alexander describes *bryanti*, sp. nov. (*Proc. U. S. Nat. Mus.* XLIX, p. 173 ♂, 1916) from Java. Type in the U. S. Museum.

Edwards records *G. nebulosa*, de Meij. from Arisan, Formosa, 8,000 ft., 10-x-12, two ♀ ♀ (*Nitobe*), including it in the subgenus *Lipophleps*.[1]

The MONGOMA group.

It seems advisable to erect two new genera in this group for forms in which the 2nd longitudinal vein is unforked. The venation appears quite constant in the three genera into which *Mongoma* has already been split up.

Alexander calls my attention to an error in my first Tipulidae paper (*Rec. Ind. Mus.* VI). On p. 291 it is stated that *australasiae*, Skuse is a strict *Mongoma*, and on p. 296 that it is congeneric with *Paramongoma*. The latter is an error; it belongs to *Mongoma, sensu strictu*. He also says there are intermediate species which throw all the genera formed

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[1] See note under *Atarba*, p. 308, respecting three species that Alexander would refer to *Leiponeura*.

out of *Mongoma* into one. If so, well and good, but I have seen specimens or figures of most of the oriental species and figures of wings of a number of others and they all fall easily into one of the five genera admitted in this paper. Of non-oriental species, *fragillima*, Westw. from Africa, *australasiae*, Skuse from Australia and *disjuncta*, Alex. from Brazil, belong to *Mongoma* (*s. str.*) ; *manca* and *pallida*, both Williston, from North America, *longifusa*, *extensa* and *niveitarsis*, all Alex. from Brazil, Panama and Porto Rico respectively belong to *Paramongoma* ; and *exornata* Bergr. from Africa, *gracilis* Ender. from Madagascar and *zambesiae*, Alex. from the Zambesi River to *Trentepohlia*.

His *disjuncta* has the anal cell open instead of closed, but this is not suggested as a generic character any more than the open or closed nature of the discal cell in those genera in which this character is understood to be variable. His *metatarsata* from Panama and his *leucozona* [1] belong to *Trentepohlia* with open instead of closed anal cell.

As the Mongomyiae form a definite natural group there can be no harm in regarding its sections as subgenera if desired.

Table of genera.

A. Fou posterior cells (discal cell present ; 3rd vein present ; anal cell closed).[2]	
B. 2nd longitudinal cell forked	*Mongoma*, Westw. (*sensu str.*).
BB. 2nd longitudinal vein simple	*Plesiomongoma*, gen. nov.
AA. Three posterior cells.	
C. 2nd longitudinal vein forked.	
D. Discal cell present ; 3rd longitudinal vein absent or very short ; anal cell open	*Paramongoma*, Brun.
D. Discal cell absent ; 3rd longitudinal vein of normal length ; anal cell closed or open	*Trentepohlia*, Big.
CC. 2nd longitudinal vein simple	*Anchimongoma*, gen. nov.

MONGOMA Westw.

cariniceps, Ender., *Zool. Jahr.* XXXII, p. 60 ♂ (1912). Sumatra. Type in Stettin Zoological Museum.

pallidiventris, Brun., *Fauna Brit. Ind. Dipt.*, p. 481 ♀ (1912). Travancore. Type in Indian Museum. This is synonymous with *tenera*, Os. Sac.

obscura, de Meij., *Bijd. tot Dierk.* XIX, p. 48 ♂ (1913). Waigou.

albipennis, *id.*, *Tijd. v. Ent.* LVI, p. 353 ♀ (1913). Java.

Types (uniques) of both species in Amsterdam Museum.

Table of Oriental species.

A. Middle tibiae with conspicuously thickened tips through the presence of short snow-white pubescence . .	*pennipes*, Os. Sac.
AA. Middle tibiae not so ornamented.	
B. Tibiae snow-white except middle third black (long 10 mm.)	*splendida*, sp. nov.
BB. Tibiae not nearly so extensively snow-white.	
C. Wings with distinct suffusion over tip of 2nd vein and at tip ; costal cell yellow	*kempi*, sp. nov.
CC. Wings clear ; costa never yellow.[3]	

[1] I have seen no reference to the description of this species.

[2] Only open in one species known to me *M. disjuncta*, Alex. from Brazil.

[3] Except in *flava* in which the whole insect is yellow, wings as well.

D. Long. 13-14½ mm.; 2nd, 3rd and 4th posterior cells equally long . . . . *cariniceps*, Ender.
DD. Long. at most 9 mm.; 4th posterior cell always longer than 3rd.
E. Legs without any white colour.
F. Pale brownish-white species; long 8 mm. . . . *albipennis*, de Meij
FF. Wholly yellow species; long 5 mm. . . . . *flava*, sp. nov.
EE. Legs with at least the tarsi white.
G. 2nd and 3rd posterior cells equally long, 4th always longer than both . . . . *tenera*, Os. Sac. (*pallidiventris*, Brun.)
GG. 2nd posterio cell as long as 4th, both distinctly longer than 3rd . . . . *obscura*, de Meij.

Mongoma splendida, sp. nov.

♂ ♀. Assam. Long. 10 mm.

Head.—Occiput and the very narrow frons ash-grey; proboscis yellowish; palpi and antennae dark brown, base of former pale.

Thorax.—Dorsum, scutellum and metanotum dark brown; pleurae and space between post sutural swellings yellowish.

Abdomen blackish-brown, hind margins of segments a little darker; a little yellowish towards sides. Belly normally pale yellowish, hind margins of segments paler, belly sometimes dark.

Legs.—Coxae orange; femora dark brown, paler towards base, tips with moderately broad snow-white ring (one-twelfth the length); tibiae snow-white, middle third dark brown; tarsi snow-white, extreme tips a little yellowish.

Wings moderately dark grey, extreme tips barely perceptibly darker; costal cell just perceptibly yellowish. Subcostal cross vein in a line with base of discal cell; 2nd vein forking at or just beyond marginal cross vein; 2nd posterior cell distinctly but only slightly longer than 3rd; 4th longer than 2nd, lengths of these three cells not exactly constant but very nearly so. Posterior cross vein at base of discal cell or fractionally before or after it. Halteres blackish.

Described from several of both sexes from above Tura, Garo Hills, 3,500—3,900 ft., vii, viii-17 (*Kemp*).

A beautiful species, quite distinct from all others.

Mongoma kempi, sp. nov.

♀. Assam. Long. 9—10 mm.

Head orange-brown; proboscis and palpi dark brown, latter paler at base; antennae yellowish-brown, paler at base.

Thorax wholly orange-yellow.

Abdomen brownish orange; an indefinite blackish dorsal stripe on 2nd and 3rd segments with the hind margins more or less blackish; hind margins of 4th to 7th segments pale yellowish. Belly brownish-yellow, the segments more or less blackish apically. Ovipositor orange yellow.

Legs orange-yellow; trochanters blackish in front; tips of femora and extreme bases and tips of tibiae black. A row of about ten minute spines at base on underside of femora; smaller and fewer spines on front pair.

Wings grey, costal and subcostal cells yellow. 2nd vein forking immediately beyond marginal cross vein; 2nd and 4th posterior cells

subequal in length, 3rd slightly shorter. A blackish suffusion extending over tip of 1st vein and marginal cross vein. Tip of wing a little blackish suffused, the colour extending inwards for less than half way to the discal cell. Veins distinctly black except as follows: proximal half of basal section of 2nd vein, its 2nd section, upper branch and basal half of lower branch; tip of 5th vein, apical half of 6th vein, and all veins at extreme base of wing yellowish. Halteres yellow.

Described from two ♀ ♀ from above Tura, Garo Hills, 3,900 ft., viii-17 (*Kemp*). In Indian Museum. A very handsome species.

Mongoma flava, sp. nov.

♀. Assam. Long. 5 mm. to tip of ovipositor.

Body all pale brownish-yellow; flagellar joints not so distinct as in the other species. Legs yellow, extreme tips of femora black.

Wings yellowish, veins yellow. Costal and subcostal cells a little deeper yellow. 2nd vein forking at marginal cross vein; 2nd and 4th posterior cells of equal length, longer than 3rd; posterior cross vein fractionally before base of discal cell. Halteres yellow.

Described from a unique ♀ in the Indian Museum from above Tura, Garo Hills, 3,500-3,900 ft., viii-17 (*Kemp*). The wholly yellow colour of this species distinguishes it from all others.

PLESIOMONGOMA, gen. nov.

Differing from *Mongoma* only in the 2nd longitudinal vein not being forked. *Type-species: P. venosa,* sp. nov.

Plesiomongoma venosa, sp. nov.

♀. Shillong. Long. 9 mm.

Head and appendages (except eyes) wholly yellowish; occiput slightly brownish. *Thorax* wholly yellowish, a little darker towards sides of dorsum; pleurae paler.

Abdomen dark brown, hind margins of segments blackish; base of abdomen dirty yellow; belly and ovipositor yellowish.

Legs (hind pair missing) wholly bright yellow to tips; anterior femora with moderately broad black ring at tip.

Wings pale grey. Costal cell distinctly though not deeply, yellow. All the veins deep black and very distinct; transverse veins very narrowly suffused, as is also base of 2nd longitudinal vein and the whole wing tip somewhat narrowly. Halteres yellow, with dirty black knobs.

Described from a unique ♀ in the Indian Museum from Shillong, 5,500—6,400 ft., 29-viii—5-ix-15 (*Kemp*), in perfect condition except for the missing hind legs. A very distinct species by the prominence of the veins as well as the difference in venation from *Mongoma.*

PARAMONGOMA, Brun.

Enderlein's *Mongomella* (*Zool. Jahr.* XXXII, p. 61, 1912) is an absolute synonym of my genus. *Albitarsis,* Dol. still remains the only oriental species.

TRENTEPOHLIA, Big.

Mongomioides, Brun. (1911).

GENOTYPE : *Limnobia trentepohlii*, W. by original designation.

Though Bigot's original description of this genus is quite valueless, Edwards recently noted [1] one of the true generic characters, the three posterior cells only, but I had overlooked his paper.

Trentepohlia trentepohlii, W.

Six specimens taken at Lampam, Patalung, Siam, 12-i-16, by Dr. Annandale.

marmorata, Brun., *Fauna Brit. Ind. Dipt.*, p. 483 ♀ (*Mongomioides*) (1912). Calcutta.

nigroapicalis, *id.*, *loc. cit.*, p. 483 ♂ (*Mongomioides*) (1912). Lucknow ; Ceylon.

albogeniculata, *id.*, *loc. cit.*, App. p. 569 ♂ (*Mongomioides*) (1912) and *Rec. Ind. Mus.* VII, p. 448 (1912).[2]

speiseri, Edw., *Ann. Mag. Nat. Hist.* (8) XII, p. 204 ♂ ♀ ; (1913) *nom. nov.* for *Mongoma exornata*, Speiser (*nec* Bergr.). Peradeniya, Ceylon. *Type* in British Museum.

saucia, Alex., *Proc. U. S. Nat. Mus.* XLIX, p. 174 ♀ (1916). Java. Type in U. S. Museum. Described under *Mongoma* with the note that it comes in the *trentepohlii* group.

pictipennis, Bezzi, *Phil. Jour. Sci.*, XII, Sect. D, p. 115 ♂ (1917). Luzon (*Baker*).

Trentepohlia ornatepennis, sp. nov.

♂. S. W. India. Long. 5 mm.

Head, including proboscis and antennae, brownish-yellow, palpi more brownish.

Thorax.—Dorsum bright brownish-yellow ; a median narrow stripe, the inner sides of the post sutural depression, the scutellum and metanotum brown. Under side of thorax brownish.

Abdomen blackish, an indistinct pale dorsal stripe ; belly more or less pale.

Legs.—Coxae brown, tips pale yellow ; remainder of legs wholly pale yellow, tarsi paler still except the brownish extreme tips.

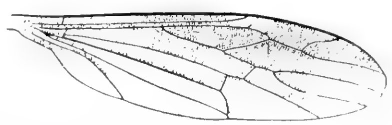

FIG. 4.—Wing of *Trentepohlia ornatipennis*, sp. nov.

Wings.—Anterior half to 4th longitudinal vein moderately dark brown, posterior half to 4th vein grey, the 5th vein and posterior cross

[1] *Ann. Mag. Nat. Hist.* (8) VIII, p. 63 (1911).

[2] The first reference antedates by about a month.

vein distinctly though narrowly suffused; the 6th and 7th veins with traces of being very narrowly suffused also. On the anterior part of the wing are a number of pale spots placed as follows. A squarish one just before middle of 1st basal cell with a small costal spot in front of it. One just beyond middle, and one nearly at tip of 1st basal cell, both of them squarish and subequal in size. A sub-triangular one in marginal cell just in front of the space between the two last-named spots. An oval one on costa at tip of 1st longitudinal vein with a small projection on hinder side nearly reaching a triangular spot placed with its base on the 3rd vein immediately in front of the inner side of the (open) discal cell. Two approximately equidistant smaller ones on costa placed between the last-named costal spot and tip of 2nd vein. Two roundish spots at tip of wing, subcontiguous. One at base of 2nd posterior cell, with a small elongate one in the cell in front of it. One at base of and one just beyond middle of 3rd posterior cell, both squarish.

Described from a unique male in the Indian Museum from Castle Rock, N. Kanara District, 11—26-x-16 (*Kemp*).

The tip of the 1st longitudinal vein is so extremely faint as to be almost invisible. The marked wings separate the species easily from all others in this group.

ANCHIMONGOMA, gen. nov.

Differing from *Paramongoma* and *Trentepohlia* by the 2nd vein being unforked. *Type-species : A. simplex,* sp. nov.

Anchimongoma simplex, sp. nov.

♂ ♀. S. W. India. Long. 5 mm.

Head.—Frons and occiput blackish-grey; proboscis, palpi and antennae brownish-grey.

Thorax considerably arched and elevated, anterior part projecting well over neck, shining dirty brown, moderately dark; scutellum and metanotum concolorous; post-sutural dorsum divided by a rather deep median furrow. Lower part of thorax yellowish-white.

Abdomen dark olive brown, hind margins of segments barely perceptibly darker; belly in ♂ pale yellowish, emarginations narrowly black, belly in ♀ barely paler; genitalia concolorous in ♂, apical part in ♀ shining brown, tips of valves yellowish.

Legs.—Coxae and base of femora yellowish, rest of femora brown, becoming paler towards tips; tibiae dirty yellowish, tarsi whitish.

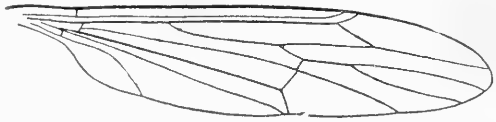

FIG. 5.—Wing of *Anchimongoma simplex*, sp. nov.

Wings pale grey; 2nd longitudinal vein not forked; discal cell absent, coalescent with 3rd posterior cell; anterior branch of 4th vein

forked, posterior branch simple; 3 posterior cells; anal cell distinctly open. Halteres blackish.

Described from a unique pair in the Indian Museum from Castle Rock, N. Kanara District, 11—26-x-16 (*Kemp*).

It seems necessary to erect a new genus for this species on the character of the unforked 2nd longitudinal vein, all the species of the three allied genera having it forked.

The absence of a discal cell is not necessarily a generic distinction from *Paramongoma*.

Lechria bengalensis, Brun.

The thorax seems to darken with age in this species, as a specimen from Calcutta, 30-v-12 (*Gravely*) has it wholly shining dark brown, as is now the case in the type ♀, though the latter was described as having it yellowish.

leucopeza, Meij., *Tijd. v. Ent.* LVI, Supp. 1913, 3 ♀, pl. i, 2, wing (Mar. 1914). Semarang, Java.

Lechria nepalensis, sp. nov.

♀. Nepal. Long. 2½ mm.

Head.—Frons ash-grey with a few stiff hairs; proboscis and palpi brownish-yellow, joints in distal half of former considerably elongate; antennal joints in apical half of flagellum long and thin.

Thorax brownish-yellow, a little whitish shimmer below shoulders and on lower part of pleurae; transverse suture deep, hind part of dorsum with a rather deep longitudinal suture; scutellum blackish.

Abdomen dark brown, posterior margins of segments and ovipositor brownish-yellow. Belly yellowish.

Legs pale yellowish.

Wings yellowish-grey, base of 3rd vein a little before midway between tip of auxiliary vein and fork of 2nd vein, and in a line with and about as long as anterior cross vein, so that the 2nd submarginal cell and 1st posterior cell are about equal in length and shape. Anterior cross vein at base of, and posterior cross vein at middle of discal cell, which is wholly beyond middle of wing, with truncate base and three short outer sides. 1st longitudinal vein turning down into 2nd as in *bengalensis*. Halteres yellowish with dark clubs.

Described from a unique ♀ in the Indian Museum from Katmandu, Nepal.

This species differs radically from *bengalensis* by its venation, but as it presents the unusual generic character of the 1st vein ending in the 2nd it is retained under *Lechria*. If a second species with similar venation to *nepalensis* and similar antennae occurs a new genus may be erected.

The venational differences from *bengalensis* are the angular base of the 3rd vein, its junction thereat with the anterior cross vein instead of the latter joining the praefurca, this cross vein being at the base instead of at the middle of the discal cell, and the position of this cell beyond the middle of the wing as well as its shape and shortness.

In *bengalensis* the flagellar joints of the antennae are more or less uniform in size, except for the usual tapering towards the tip, but in *nepalensis* those on the apical half are considerably attenuated and lengthened.

CLYDONODOZOS, Enderl.[1]

Zool. Jahr. XXXII, p. 5 (1912).

GENOTYPE : *C. multistriatus*, sp. nov., by original designation.

multistriatus, Enderl., *loc. cit.*, p. 57 ♂ ♀ (1912).
punctulatus, *id.*, *loc. cit.*, p. 59 (sex ?) (1912).
Both species from Sumatra ; types in Stettin Zoological Museum.
griseiceps, de Meij., *Tijd. v. Ent.* LVIII, Supp. p. 11 ♀, 1915 (1916). Sumatra. Unique type in Amsterdam Museum.

GNOPHOMYIA, Os. Sac.

This genus was imperfectly understood by me in my "Fauna" volume, and my thanks are due to Mr. Alexander for pointing out several errors. *G. longipennis*, Brun.=*Rhaphidolabis fascipennis*, Brun. ; *G. aperta* and *incompleta* belong to *Rhaphidolabis* ; *G. genitalis* and *furcata* to *Limnophila*. *G. strenua* and *nigra* are true *Gnophomyiae*.[2]

G. ornatipennis, Meij. is referred by Edwards to *Gymnastes*, whilst Alexander places it in *Paratropeza*, Sch. Riedel records a ♂ of this species from Formosa.

Edwards records (*Ann. Mag. Nat. Hist.* (8) XVIII, p. 250, 1916) *G. orientalis*, Meij. from Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*), and describes a new species *similis* (p. 251) from the same locality and collector, the unique type being in the British Museum.

DASYMALLOMYIA, Brun.

According to Alexander this genus is identical with a group of thickset, tropical American species of *Gnophomyia* with short, hairy legs and some other characters.

Mr. Edwards more recently proposes to retain the genus provisionally for species of the group mentioned, and describes three new species from the Malay Peninsula : *maculipleura* (*Ann. Mag. Nat. Hist.* (8) XVII, p. 360 ♂ ♀, fig. 5, p. 356, genitalia, 1915) ; *fraterna*, *l. c.*, p. 361 ♂, fig. 6, p. 356, genitalia, Selangor ; *nigrescens*, *l. c.*, p. 361 ♀, Talum, Perak ; the types of all three species being in the British Museum.

Dasymallomyia signata, Brun.

Edwards records a ♀ from Horisha, Formosa, 10-v-13 (*Maki*).

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[1] Alexander says that Edwards doubts if this is distinct from *Conosia*.

[2] *G. longipennis*, Brun., "*Fauna*", p. 489, pl. ix, 17 ; *aperta*, p. 492, pl. x, 1 ; *incompleta*, p. 493, pl. x, 2 ; *genitalis*, p. 490, pl. ix, 16 ; *furcata*, p. 491, pl. ix, 8 ; *strenua*, 492, pl. ix, 19 ; *nigra*, p. 494, pl. x, 3 (1912).

OXYDISCUS, Meij.

Tijd. v. Ent. LVI, 350 (1913).

GENOTYPE: *O. nebulosus* Meij. by original designation.

nebulosus, de Meij., *loc. cit.*, p. 351 ♀. West Java. Unique type in Amsterdam Museum.

umbrosus, Edw., *Ann. Mag. Nat. Hist.* (8) XVII, p. 361 ♀ (1916). Kedah Peak, 3,200 ft. Malay Peninsula (*Dr. Stanton*). The unique type in the British Museum.

Conosia irrorata, W.

A ♀ of this widely distributed species taken by Dr. Annandale at Otsu, near Kyoto, Japan, x-15. Also recorded recently from Kotosho I., Formosa, 5-viii-12 (*Shiraki*).

CLADURA, Os. Sac.

My *C. flavescens* is almost certainly a *Cladura* in Osten Sacken's sense, agreeing with his description and with Needham's figure of the wing, so I think Alexander is in error in claiming that my species is generically wrongly placed.

Cladura interrupta, sp. nov.

♀. Darjiling. Long. $3\frac{1}{2}$—4 mm.

Head yellowish-grey; antennal scape and base of flagellum yellow, remainder blackish.

Thorax brownish-yellow.

Abdomen very dark brown with short pubescence; ovipositor long, brownish-yellow towards tip.

Legs wholly pale yellow, distinctly pubescent throughout; coxae black.

Wings yellowish-grey with numerous black spots, of which the deepest is over the stigma, nearly oblong in shape, emarginate on hinder side; a minute well defined costal spot near the base. Three narrow, transversely placed costal spots nearly equidistant, extending posteriorly to (1) hind margin of 2nd basal cell, (2) hind margin of 1st basal cell, and (3) to the anterior cross vein. A good sized spot at tip of upper branch of 2nd vein, more or less connected with round spots in the 2nd submarginal and 1st posterior cells, and with another at the fork of the upper branch of the 4th vein, and one at the tip of the 3rd posterior cell, forming altogether a slightly bent band across the wing. A spot at tip of lower branch of 2nd vein and one at tip of all the 4th vein endings, at tips of 5th, 6th and 7th veins, and over inner and outer sides of discal cell. Ground colour of wing slightly darker grey over basal half or thereabouts of both basal cells and of the anal and axillary cells. Halteres dirty yellowish. The 1st submarginal cell is divided a little beyond the middle by a supernumerary cross vein.

Described from two ♀♀ in the Indian Museum from Pashok, 3,500 ft., 26-v—14 vi-16 (*Gravely*).

CLADUROIDES, Brun.

This will be synonymous with *Rhaphidolabis*, Os. Sac. if the apparent discrepancy in the number of joints in the antennae can be satisfactorily accounted for, otherwise it is a perfectly valid genus.[1]

PARACLADURA, Brun.

Alexander says this genus has no relationship with *Cladura*, Os. Sac., but he does not say where he would place it ; presumably in the Amalopini.

Its characters are : (1) no tibial spurs, the closest examination revealing no trace of them, (2) subcostal cross vein near middle of wing, some distance after origin of praefurca, (3) eyes minutely but obviously pubescent,[2] (4) no *frontal* gibbosity but the *face* very distinctly gibbous, (5) antennae with the scapal joints very short, sub-globular ; the flagellum of 15 elongate joints, (6) five posterior cells, the 4th distinctly pointed at base.

The 17-jointed antennae makes the genus rather abnormal, wherever placed. The absence of tibial spurs would relegate the genus to the Eriopterini, but if exceptions to this character are admitted it must fall either in the Amalopini or the Limnophilini.

Paracladura agrees and disagrees respectively with the various characters of the Eriopterini and Amalopini as shewn in the following table :—

Paracladura.

ERIOPTERINI.	AMALOPINI.
Agrees in—	Agrees in—
1. No tibial spurs.	1. 5 posterior cells, especially in pointed base of 4th.
2. No frontal bump.	2. Pubescent eyes.
3. 5 posterior cells.	Disagrees in—
4. Position of subcostal cross vein.	1. No tibial spurs.
Disagrees in—	2. No frontal bump.
1. Pubescent eyes.	3. Position of subcostal cross vein.[3]

As regards the Limnophilini, *Paracladura* has little or nothing in common ; the absence of tibial spurs, the position of the subcostal cross vein and the pubescent eyes all separate it.

Apparently, therefore, although rather abnormal, it agrees best with the characters of the Eriopterini, where it may remain for the present.

Section *AMALOPINI.*

TRICHOCERA, Mg.

punctipennis, Brun., *Fauna Brit. Ind., Dipt.*, p. 511, ♂ ♀ (1912). Simla.

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[1] See note under *Rhaphidolabis*, p. 322.

[2] In my description this fact was not stated, the pubescence being overlooked ; close examination is required to detect it.

[3] That is to say, according to Osten Sacken's characterisation of the section. If *Trichocera* be allowed to remain in the Amalopini, *Paracladura* will not disagree in this character.

flava, *id., loc. cit.*, p. 512 ♀ (1912). Darjiling.
montana, *id., loc. cit.*, p. 513 ♂ (1912). W. Himalayas.
Types of all three species in Indian Museum.

AMALOPIS, Hal.

glabripennis, Brun., *Fauna Brit. Ind. Dipt.*, p. 515 ♂ (1912). Darjiling and North-East Indian Frontier.
elegans, *id., loc. cit.*, p. 516 ♂ ♀ (1912). Kurseong.
Types of both species in Indian Museum.

As regards the right of *Amalopis* or *Tricyphona*, Zett. to stand Bergroth's recent argument [1] appears just and I agree with it, but it seems inadvisable to change generic names that give their names to families, sub-families or sections, and for that reason it is retained here.[2]

Amalopis spectralis, sp. nov.

(Plate vii, fig. 4.)

♂. Darjiling. Long. 6 mm.

A very peculiar whitish ghost-like fly.

Whole body pale yellowish; thorax whitish, indistinctly shewing a darker surface below; proboscis and palpi dark; antennae snow-white, the minute similarly coloured pubescence making determination of the exact number of joints impossible. Neck rather long. Abdomen a little darker towards tip; genitalia large and conspicuous, pale yellowish-brown with long pale hairs; a large curved dorsal plate; a very elongate, ventral, curved plate turning upward at the tip, which is bifid; claspers of moderate size.

Legs wholly nearly snow-white except tips of femora and of tibiae broadly black; tarsi tips a little brownish.

Wings clear, very iridescent; veins whitish. 3rd vein issuing from the very short space between the anterior cross vein and the fork of the 2nd vein, and parallel with the branches of the latter, so that both submarginal cells and the 1st posterior are about subequal. Basal section of 2nd vein, marginal cross vein, and a line formed of the basal portion of upper branch of 2nd vein, the anterior and posterior cross veins, also the veinlet forming outer side of discal cell, very narrowly but deeply suffused. Halteres yellowish-white.

Described from a single nearly perfect ♂ in the Indian Museum. Pashok, Darjiling District, 3,000 ft., 26-v—14-vi-16 (*Gravely*).

ULA, Hal.

javanica, Alex., *Proc. U. S. Nat. Mus.*, XLIX, p. 176 (1916). Java. Type in U. S. Museum.

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[1] *Ann. Mag. Nat. Hist.* (8) XI, p. 583 (1913).

[2] Mr. Bergroth draws attention to the use in my Fauna volume of *Pleciomyia* in place of *Crapitula*, Gimm. in the family Bibionidae. This was not an arbitrary proceeding on my part, as he assumes. The description of *Crapitula* is not accessible in India and the Kertesz catalogue gives it as a synonym of *Plecia*. Recognising the distinctness generically of *melanaspis* it appeared necessary to erect a new genus for it.

RHAPHIDOLABIS, Os. Sac.

? *Claduroides*, Brun., *Rec. Ind. Mus.* VI, p. 288 (1911).

Five species recently described by me belong to this genus.

sordida, Brun., *Rec. Ind. Mus.* VI, p. 290 ♂ ♀ (*Claduroides*) (1911). Simla; Kurseong. Types in Indian Museum.

fascipennis, *id.*, *loc. cit.*, p. 289 ♂ ♀ (*Claduroides*) (1911).

Gnophomyia longipennis, Brun., *Fauna Brit. Ind.*, p. 489 ♀ (1912). *Rhaphidolabis fascipennis*, *id.*, *loc. cit.*, p. 519 ♀ (1912). Darjiling; Kumaon and Simla Districts. Types of all the forms in the Indian Museum.

aperta, Brun., *Fauna Brit. Ind. Dipt.*, p. 492 ♂ (*Gnophomyia*) (1912). Darjiling. Edwards changes the specific name (*Ann. Mag. Nat. Hist.* (8) XVIII, p. 254) to *brunetti*, through preoccupation by Coquillet. He records a ♀ from Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*).

incompleta, *id.*, *loc. cit.*, p. 493 ♂ (*Gnophomyia*) (1912). Kurseong. The types of both these species in the Indian Museum. Alexander has noted that *incompleta* would come in *Plectromyia*, Os. Sac., which is now generally considered synonymous with *Rhaphidolabis* or at most a subgenus of it.

indica, Brun., *Fauna Brit. Ind.*, p. 519 ♂ ♀ (1912). Simla District. Types in Indian Museum.

It must be noted that in all the above five species before me the antennae contain 15 joints. Alexander, in relegating my *Claduroides* to a synonym of *Rhaphidolabis*, overlooks the fact that the latter genus has only 13-jointed antennae. I noted this discrepancy in referring my *indica* and *R. fascipennis* to this genus. Possibly Osten Sacken was in error, but this is unlikely, or possibly he wrote "antenna" in mistake for "flagellum"; and possibly Williston (*Manual N. Amer. Dipt.*) merely copied him in the table of genera, but I have seen no correction of the original statement of a 13-jointed antenna. If *Rhaphidolabis* really has only 13-jointed antennae, *Claduroides* must stand as a valid genus.

TIPULODINA, Ender.

Erected for a small group of Tipulae with white-banded legs and white tarsi and referred by its author to this section. I have endeavoured (p. 270) to shew they are merely *Tipulae*, and the species are noted under that genus.

Section *LIMNOPHILINI*.

LIMNOPHILA, Macq.

Six of my recently described species belong here.

genitalis, Brun., *Fauna Brit. Ind. Dipt.*, p. 490 ♂ ♀ (*Gnophomyia*) (1912). Kumaon District. Only the type ♂ and ♀ are known.

furcata, *id.*, *loc. cit.*, p. 491 ♂ ♀ (*Gnophomyia*) (1912). Darjiling.

pallidicoxa, *id.*, *loc. cit.*, p. 523 ♀ (1912). Kumaon and Darjiling.

simplex,[1] *id., loc. cit.*, p. 523 ♀ (1912). Kumaon District. Unique.

multipunctata, *id., loc. cit.*, App. p. 569, (sex ?) (1912). Darjiling District.

honesta, *id., loc. cit.*, App. p. 570 ♀ (1912). Kumaon District.

claripennis, *id., Rec. Ind. Mus.* VIII, p. 153 ♀ (1913). North-East Indian Frontier.

quartarius, *id., loc. cit.*, p. 154 ♂ ♀ (1913). North-East Indian Frontier.

Types of all above species in Indian Museum.

apicalis, de Meij., *Nova Guin. Res.* IX, p. 309 ♀ (1915). Papua.

javana, de Meij., *Tijd. v. Ent.* LIX, p. 198 ♂ ♀, pl. vii, 11 (wing) (1916). Gedeh, Java, 1,500—2,000 metres, June (*Konigsberger*).

amica, Alex., *Proc. U. S. Nat. Mus.* XLIX, p. 175 ♂ (1916). Java.

palmeri, *id., loc. cit.*, 175 ♂. Java.

Types of both these species in the U. S. Museum.

Table of Oriental species of LIMNOPHILA.

A. Wings very conspicuously marked.	
(*a*) Wings blackish, with base, a middle band and tip white	*trisignata*, Walk.
(*b*) Wings cinereous, veins black, bordered with black .	*selectissima*, Walk.
(*c*) Wings brownish-yellow, with very numerous minute black dots	*multipunctata*, Brun.
(*d*) Wings brownish-grey, with numerous small white spots	*ornatipennis*, sp. nov.
(*e*) Wings distinctly yellowish with brown markings .	*flavipennis*, sp. nov.
AA. Wings quite unmarked; stigma present or absent.	
B. Four posterior cells.	
C. Marginal cross vein present; discal cell at least twice as long as broad.	
D. Marginal cross vein joining praefurca . . .	*honesta*, Brun.
DD. Marginal cross vein joining 2nd vein before the fork .	*amica*, Alex.
DDD. Marginal cross vein joining upper branch of 2nd longitudinal vein.	
E. 2nd submarginal cell as long as 1st posterior; legs unringed	*quartarius*, Brun.
EE. 2nd submarginal cell much longer than 1st posterior.	
F. Femora with subapical yellowish ring on all femora .	*annulipes*, sp. nov.
FF. Femora without such ring	*inconsequens*, sp. nov.
CC. Marginal cross vein and stigma both absent; discal cell barely longer than its greatest breadth . . .	*parvicellula*, sp. nov.
CCC. Marginal cross vein absent[2]; stigma present even if weak	
G. Discal cell present	*palmeri*, Alex.
GG. Discal cell absent	*incompleta*, sp. nov.
BB. Five posterior cells.	
H. Larger species, 12 mm. long	*contingens*, Walk.
HH. Smaller species, at most 8 mm. long.	
I. Marginal cross vein present.	

[1] The name *simplex* preoccupied by Alexander but as my *simplex* is synonymous with *genitalis*, Brun. it may be allowed to lapse.

[2] Alexander does not state its absence, but it is not apparent in his figure, and he states its presence in the previous species, *amica*.

J. 2nd longitudinal vein forking *after* marginal cross vein; posterior cross vein at base of discal cell; thorax yellowish-brown . . . . *pallidicoxa*, Brun.

JJ. 2nd longitudinal vein forking almost exactly *at* marginal cross vein; posterior cross vein at middle of discal cell; thorax ash grey . . . . . . *genitalia*, Brun. (*simplex*, Brun.)

JJJ. 2nd longitudinal vein forking *before* marginal cross vein.

K. 2nd posterior cell small, triangular; legs all pale yellow; small delicate species with clear, slightly iridescent wings, stigma indistinct; veins pale . . . . *furcata*, Brun.

KK. 2nd posterior cell of normal size, oblong; legs (except paler basal part of femora) all dark, especially towards tips of femora.

L. Head and thorax mainly rather bright brownish-yellow; wings very glabrous, stigma black, distinct. Long $5\frac{1}{2}$ mm. . . . . *glabra*, sp. nov.

LL. Head grey, thorax yellowish-brown with thin median black line; wings less glabrous, stigma practically absent; long 4 mm. . . . . *fusca*, sp. nov.

II. Marginal cross vein absent (2nd vein forking soon after origin of 3rd, both branches parallel nearly to tips; 1st submarginal cell nearly as long as 2nd) . . . . *claripennis*, Brun.

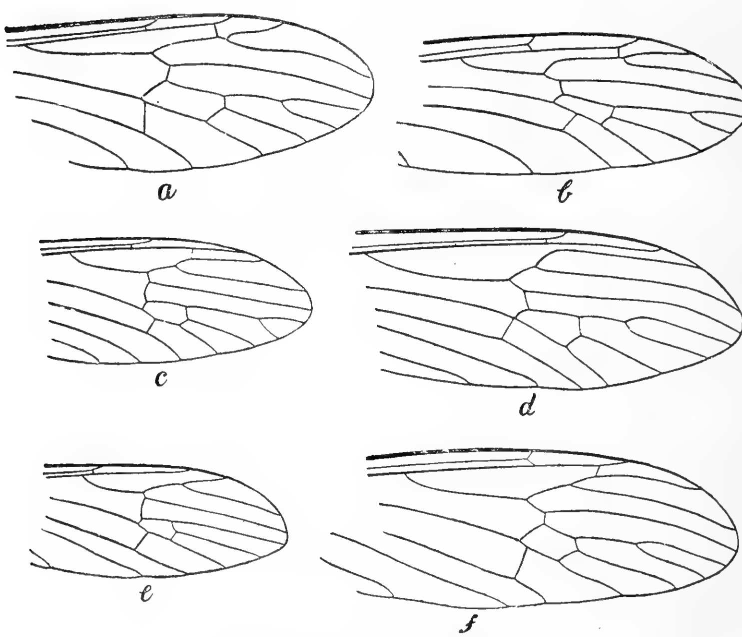

FIG. 6.—Wings of *Limnophila* spp.
a.—*L. pallidicoxa*, Brun
b.—*L. genitalis*, Brun.
c.—*L. furcata*, Brun.
d.—*L. claripennis*, Brun.
e.—*L. parvicellula*, sp. nov.
f.—*L. glabra*, sp. nov.

Limnophila annulipes, sp. nov.

♂. S. W. India. Long. 7 mm.

Head and palpi rather dark brown; antennae brownish-yellow, 2nd scapal joint more yellowish; 1st flagellar joint cup-shaped, next

five joints short, cylindrical, about as long as broad, the remainder gradually lengthening.

Thorax cinnamon brown, the considerably depressed humeral region blackish. Sides of thorax moderately light grey, with a black lateral stripe just below dorsum; under side also black; metanotal region a little paler.

Abdomen cinnamon brown, sides of segments blackish, ovipositor brownish-yellow; belly more or less yellowish.

Legs.—Coxae pale yellowish-white; femora yellowish, apical part blackish with a distinct subapical yellowish ring; tibiae and tarsi yellowish-brown.

Wings brownish-grey, considerably iridescent; 4 posterior cells; stigma moderately distinct; marginal cross vein apparently present though extremely faint, joined to the very short upper branch of 2nd longitudinal vein; 2nd submarginal cell considerably longer than 1st posterior. Anterior cross vein at base of discal cell; posterior cross vein at just beyond one-third; 2nd and 3rd posterior cells rather longer than discal cell.

Described from a single ♂ in the Indian Museum from Talewadi, near Castle Rock, N. Kanara District, 3—10-x-16 (*Kemp*).

This is the only species known to me with distinct rings on its legs.

Limnophila parvicellula, sp. nov.

♂. S. W. India. Long. $3\frac{3}{4}$ mm.

Head moderately dark brown; antennae similar; flagellar joints all elongate and slender, only the first two or three slightly thicker.

Thorax and *abdomen* brownish-yellow; dorsum darker brown; genitalia brownish-yellow.

Legs dark brown, nearly black.

Wings grey, iridescent; 4 posterior cells; marginal cross vein absent; upper branch of 2nd vein short, as long as from tip of praefurca to fork of 2nd. Anterior cross vein exactly at origin of 3rd vein and at base of discal cell, the latter unusually small, about one-third as long as 2nd posterior cell; posterior cross vein a little before middle of discal cell. Halteres obscure.

Described from a single ♂ from Talewadi, near Castle Rock, N. Kanara District, 3—10-x-16 (*Kemp*).

The absence of the marginal cross vein and small size of the discal cell are the chief characters of this species.

Limnophila glabra, sp. nov.

♂. S. W. India. Long. $5\frac{1}{2}$ mm.

Head set on a rather long neck; brownish-yellow below, occiput (bearing some rather long black hairs) and frons blackish-grey; proboscis brownish-yellow; palpi black; antennae blackish-brown, basal half of 1st scapal joint yellowish; flagellar joints elongate and very narrow except the basal two or three slightly thicker.

Thorax rather bright brownish-yellow; dorsum shining blackish-brown, metanotum shining brown with bluish-grey reflections viewed from behind.

Abdomen.—Dorsum blackish, shining; belly wholly bright brownish-yellow; genitalia brownish-yellow, pubescent.

Legs.—Coxae bright brownish-yellow; femora brownish-yellow at base, gradually darkening to black at tips; tibiae and tarsi dark yellowish-brown, nearly black.

Wings grey, very shining and iridescent; 5 posterior cells; marginal cross vein present, 2nd vein forking distinctly before that cross vein, its upper branch long and slightly diverging throughout its length from lower branch. 2nd submarginal cell distinctly longer than 1st posterior; 2nd posterior cell rather longer than its pedicle; discal cell not much longer than broad; anterior cross vein placed at upper angle of that cell; posterior cross vein just beyond its base. Halteres dirty yellowish-brown.

Described from a single ♂ in the Indian Museum from Castle Rock, N. Kanara District, 11—26-x-16 (*Kemp*).

Limnophila fusca, sp. nov.

♂ ♀. Darjiling. Long. about 5 mm.

Head rather dark grey; antennal scape blackish, basal flagellar joint yellowish, remainder blackish, the joints considerably elongated, with long verticils.

Thorax moderately dark yellowish-brown; a narrow median dark line; pleurae a little lighter here and there; scutellum and metanotum concolorous.

Abdomen.—Dorsum and belly concolorous with thorax; segments very distinct; genitalia moderate in size.

Legs dull yellowish-brown, coxae and the femora for a considerable distance from base (in certain lights) paler; legs in ♀ rather paler than in ♂.

Wings grey; 2nd vein forked soon after origin of 3rd vein; marginal cross vein a little beyond the fork; stigma practically absent; 2nd posterior cell twice as long as its petiole; 5 posterior cells.

Described from 2 ♂ ♂ and 1 ♀ in Indian Museum from Sureil, Darjiling District, 5,000 ft., iv, v-17 (*Kemp*).

Limnophila incompleta, sp. nov.

♂. Darjiling. Long. 4 mm.

Whole body dark brown; flagellar joints of antennae oval, verticils rather short. Abdominal segments distinct, roughened. Legs dirty brown. Wings grey; marginal cross vein absent; 2nd vein forked at about usual place; *discal cell open*, coalescent with 3rd posterior cell; 2nd posterior cell considerably longer than its petiole; 4 posterior cells.

Described from three ♂ ♂ in Indian Museum from Sureil, Darjiling District, 5,000 ft., iv, v-17 (*Kemp*).

Limnophila inconsequens, sp. nov.

♂. S. W. India. Long. 5—6 mm.

Head brownish-yellow; antennae and palpi dark brown, base of former more or less and to an irregular extent pale.

Thorax and *abdomen* brownish-yellow, hinder half of segments of latter blackish, sometimes all the dorsal surface of abdomen blackish; genitalia brownish-yellow.

Legs wholly dull brownish-yellow; femora rather darker towards tips.

Wings grey, shining, moderately iridescent; four posterior cells. Marginal cross vein present, joined to the short oblique upper branch of 2nd vein; 2nd submarginal cell distinctly longer than 1st posterior. Anterior cross vein at base of discal cell; posterior cross vein at or just before its middle. Halteres obscurely yellowish, tips darker.

Described from a short series of ♂ ♂ from Castle Rock, N. Kanara District, 11—26-x-16 (*Kemp*).

This species is without any special character, but may be easily recognised from the table of species.

It bears considerable resemblance to *glabra* but possesses only four posterior cells.

Limnophila flavipennis, sp. nov.

(Plate viii, fig. 14.)

♀. Darjiling. Long. 15½ mm. to end of ovipositor.

Head and proboscis greenish-grey with a brown irregular median stripe from neck to antennae; palpi and antennae dark brown, scapal joints paler. Neck and collare pale yellowish-grey with a dark brown stripe each side of former.

Thorax wholly greenish-grey with the three usual dorsal stripes olive green.

Abdomen dark brown with hind margins of segments and sides narrowly rather light brown; belly similar.

Legs.—Coxae greenish-grey, rest of legs blackish-brown, base of fore femora paler brown.

Wings yellowish with dark brown markings. A transverse streak just beyond humeral cross vein, carried along bases of both basal cells, narrowing gradually; a moderately narrow stripe from costa to 4th vein, situated at one-third the length of the wing; a similar stripe widening hindwards, from costa to 4th vein, passing over base of 3rd vein; an apparent continuation of this stripe, only narrower, beginning at 5th vein and reaching hind border of wing; a stripe, comprising within it some clear spots, beginning on costa at tip of 1st vein, continuing over the "cross veins" to 5th vein, where it turns slightly outwards, ending irregularly on wing border; this stripe being wide enough to include a comparatively clear narrow space on each side of the "cross veins"; a branch of this stripe diverging at 3rd vein, continuing over distal side of discal cell, where it divides, the ends reaching the wing border over tips of two last endings of 4th vein in the shape of spots with a clearer centre; a similar spot over tip of 2nd posterior cell; a short vertical stripe from costa over marginal cross vein ending at lower branch of 2nd vein; a similar one over tip of 1st submarginal cell and a small spot at extreme wing tip. Veins dark brown; halteres yellowish.

Described from a unique ♀ in my own collection taken by me at Darjiling, 6,900 ft., 17-v-17.

Limnophila ornatipennis, sp. nov.

(Plate vii, fig. 5.)

♂ ♀. Darjiling. Long. 8—9 mm.

Head.—Frons, face, occiput and proboscis orange, a little darker here and there, and with scattered pale hairs ; a row of black stiff hairs across the vertex ; epistome with several rather long stiff brown hairs ; palpi dark brown, hairy. Antennal scape dark brown ; basal joint of flagellum enlarged, bright chrome yellow, remaining joints light brown.

Thorax, including the distinct ring-like collare, scutellum and metanotum brownish-yellow ; pleurae rather darker and more brownish ; a little whitish shimmer on mesopleura and sternopleura.

Abdomen rather dark brown ochre tinged with yellow about discs of segments ; sparsely pale pubescent and with a whitish shimmer on dorsum and sides in certain lights. Genitalia in ♂ dark brown ; a broad dorsal plate, the centre elevated sharply like an inverted V ; a large bright yellow basal joint with concolorous hairs and comparatively small brown hook-like 2nd joint. Ovipositor brownish-yellow.

Legs brownish-yellow, hind coxae rather darker ; a just perceptible pre-apical darker band on all femora ; tips of tarsi brownish.

Wings rather dark brownish-grey, rather darker over stigma, bifurcation of 2nd and 3rd veins, apical two-thirds of 3rd vein and tips of veins in its vicinity, and along 5th vein. Small pale spots are distributed as follows. Costal cell divided by transverse dark narrow lines into about ten small pale spots, some quite clear, others pale grey ; the two largest and clearest at about middle of costa, with a similar spot contiguous, just below auxiliary vein. A semicircular spot just below stigma, nearly reaching 3rd vein, and beyond it on the costa a triangular one in 1st submarginal cell ; one in 2nd submarginal cell and one at tip of each posterior cell, and three or four in each basal cell. 1st posterior cell with a larger basal and two central smaller spots ; 2nd posterior cell with only the apical spot and a faint very small one at base ; 3rd posterior cell with a larger one near base ; 4th posterior cell with a basal smaller one. Discal cell with a larger middle one and a smaller one at base and tip ; anal cell with three larger approximately equidistant ones and a small one at tip ; 1st axillary cell with a large basal one extending to the middle, and a rather large one connecting with 3rd spot in anal cell, and contiguous with wing-margin ; 2nd axillary cell with one before the middle and one at tip. Halteres pale yellow with cream yellow knobs.

Described from a type ♂ from Soom, Darjiling District, 4,000–5,000 ft., 14-vi-14 and type ♀ Darjiling, 7,000 ft., 12-vi-14 (both *Gravely*).

The above description of the wing applies to the ♂ ; the ♀ shewing slight differences, but not enough to prevent the species being recognised without doubt.

Note on ? gen. nov. near *Limnophila* from Japan.

In addition to 7 ♀ ♀ of a *Limnophila* with a ♂ that may belong to the same species which latter I am unable to identify, Dr. Annandale captured four ♂ ♂ at Otsu, near Kyoto, Japan, 6-x-15, which I fail

to place generically. These four specimens (further specimens in spirit) represent a conspicuous species with a very unusual venation, yet undoubtedly allied to *Limnophila,* though no tibial spurs are perceivable. The costa is broadly yellowish; a narrow brownish-yellow curved streak from fork of 2nd vein, embracing the discal cross vein and reaching the hind margin of the wing. Another similar streak from the fork of the 2nd vein, suffusing the anterior and posterior cross veins. Body and legs practically wholly pale yellow. This species was found by Dr. Annandale dancing in a small swarm about a foot and a half from the ground at dusk in a shady lane near Kyoto, Japan, 6-x-15. There are several genera in Limnophilini that I am unable to compare, the works in which they are described not being accessible in India.

EPHELIA, Sch.

fascipennis, Brun., *Fauna Brit. Ind. Dipt.,* p. 526 ♂ (1912). Kurseong; Pashok, Darjiling District, 3,500 ft., vi-16 (*L. C. Hartless*). Edwards records a ♀ from Arisan, Formosa, 8,000 ft. (*Nitobe*) as probably this species, and Mr. Kemp took one at Tura, Garo Hills, Assam, 1,200–1,500 ft., vi-17. The apical femoral rings are quite black.

ornata, Brun., *Fauna Brit. Ind. Dipt.,* p. 527 ♀ (1912). Kumaon District.

Types of both above species in Indian Museum.

DICRANOPHRAGMA, Os. Sac.

pulchripennis, Brun., *Fauna Brit. Ind. Dipt.,* p. 524 ♂ (1912). Darjiling District.

A specimen from Bhoirakund, Assam-Bhutan Frontier, Darrang District, 18—22-x-12 (*Kemp*), has the wing markings slightly different, also the legs bear much longer and more distinct pubescence.

gracilis, *id., Rec. Ind. Mus.* VIII, p. 156 ♀ (1913). N. E. Indian Frontier.

Types of both species in Indian Museum.

remota, de Meij., *Tijd. v. Ent.* LVI, Supp. 1913, 1 ♂ ♀, pl. i, 1, wing (Mar. 1914). Java.

Dicranophragma multipunctipennis, sp. nov.

(Plate viii, fig. 17.)

♂. Darjiling. Long. 7 mm.

Head.—Occiput dark yellowish-grey; frons darker brown, a narrow rregular median stripe along both; proboscis and palpi dark brown; antennae yellowish, 1st scapal joint dark brown.

Thorax.—Dorsum yellowish-grey, considerably sunken on each side just behind anterior border, with (seen from in front) a curved dark

brown stripe and a small black spot below it, both in the sunken space. Scutellum and metanotum yellowish-grey; sides of thorax moderately dark brown.

Abdomen brownish-yellow with yellow pubescence; hind margins and sides of segments broadly but rather irregularly dark brown. Belly similar; genitalia concolorous.

Legs (front and hind pair missing). Coxae dark brown, remainder wholly yellow.

Wings pale grey with four larger (though still comparatively small) brown spots on costa and very numerous minute pale brown spots. The first of the larger spots placed just before one-fourth of the wing, reaching to hind margin of 2nd basal cell; a similar stripe-like spot just before middle of wing reaching to hind margin of 1st basal cell; a darker brown triangular spot over stigmatic region (the largest spot of all) extending, gradually narrowing, over "cross veins," disappearing at wing border over tip of 5th vein; a roughly triangular preapical spot with its apex reaching hind margin of 2nd submarginal cell, and an apical spot extending from tip of 1st submarginal cell to 3rd posterior cell. Very numerous small paler brown elongate or oval dots or spots placed transversely to axis of wing in all the cells, very few being situated actually on the veins. Halteres pale yellow.

Described from a unique ♂ in my own collection taken by me at Darjiling, 15—19-v-17.

Epiphragma kempi, Brun.

Edwards has suggested the identity of this with *signata*, de Meij., but though closely allied the wing markings are sufficiently constant to warrant ranking it as distinct. Two ♂♂ and two ♀♀ from the Garo Hills show slight differences but are obviously all of one species. In all of them the extra cross vein in the costal cell is distinctly though narrowly suffused. The new species *vicina* is also closely allied in the wing pattern but I am convinced all three are quite good species.

Epiphragma klossi, sp. nov.

(Plate viii, fig. 16.)

♂. Malay States. Long. 9 mm.

Head cinereous; 1st scapal joint cinereous, large, long, cylindrical; 2nd dark, short; 1st flagellar joint longer and larger than 2nd scapal, orange; rest of flagellum black; palpi blackish-grey.

Thorax yellowish-grey, a broad transverse blackish band in front of suture, not reaching sides; a median reddish-brown narrow stripe from anterior margin, narrowing hindwards and reaching the transverse band, and on each side of this stripe a longitudinally placed oval blackish spot clear of the margins, and contiguous to another similar spot on lower edge of dorsal margin in front of wing base; hind part of dorsum yellowish-grey with darker marks; scutellum and metanotum grey with tomentose yellow pubescence, former a little blackish basally.

Abdomen dark nut-brown, extreme hind margin of each segment pale; genitals concolorous.

Wings pale grey with a brown pattern much resembling that of *E. kempi*, Brun. The general impression of this pattern is that of three circles with flattened tops; the first near the base, reaching from the costa to the 6th vein, contiguous to the 2nd circle which extends from costa to 5th vein. 3rd circle more nearly oval, placed a little slanting, reaching from 1st to 5th veins, the upper outer part broken in upon by a longitudinal spot filling basal third of 2nd submarginal cell; a similar spot over stigmatic region, ending at tip of 1st vein. Contiguous to inner end of this spot, a very small dark brown circle on costa, and between this small circle and the top of the 2nd large " circle " first described, a short transverse stripe from costa to 1st longitudinal vein, followed (distally) by an inverted V, similarly placed. At tips of upper and lower branches of 2nd longitudinal vein, a narrow spot extending into 2nd submarginal cell; an oval spot over outer side of discal cell, reaching to lower branch of 2nd longitudinal vein, extended downward and curving basally across middle of 5th posterior cell and nearly filling tips of anal and 1st axillary cells. Tips of 3rd vein and all endings of 4th vein with a small spot on each; the first two connected with a spot covering base of 2nd posterior cell, which is itself joined narrowly to the oval spot over outer side of discal cell. Anterior cross vein and base of discal cell narrowly infuscated, forming a short stripe in middle of 3rd " circle." From the 2nd " circle " a stripe passes through anal cell, and bending distally broadens and ends on hind margin over tip of axillary vein. Basal third of 2nd axillary cell brown with a square spot about its middle. Extreme base of wing brown; costa at extreme base clear; humeral cross vein narrowly infuscated, and a short stripe between this and absolute base of costa. A minute dot here and there contiguous to the various spots, or isolated, apparently of irregular distribution. Halteres dark grey.

Described from a unique ♂ in good condition in the Indian Museum from Ginting Bidai, 2,000 ft., Selangor-Pahang Frontier, Federated Malay States, April 1917 (*C. Boden Kloss*).

Easily recognised from *kempi* by the wholly black femora.

Epiphragma vicina, sp. nov.

(Plate viii, fig. 15.)

♀. Assam. Long. 10 mm. to tip of ovipositor.

Head yellowish-grey; an oval blackish transverse spot on vertex, continued hindwards as a gradually narrowing median stripe on occiput; a post-ocular row of stiff hairs and smaller irregular hairs. Proboscis brownish-yellow; palpi dark brown; antennal 1st scapal joint grey, 2nd black, 1st flagellar joint orange, a little longer than 2nd scapal, remaining joints black.

Thorax rather bright brownish-yellow, prothorax a little paler; collare with transverse dark brown mark above. Dorsum with a very short median dark stripe and two broader and rather longer outer stripes, all connected narrowly on anterior margin; these outer stripes extending nearly to a pair of large dark, more or less squarish spots in front of suture, narrowly separated from one another. Ground colour

behind the suture brownish-yellow, with a dark brown half-moon spot with its convex side hindward ; hind margin of dorsum and the scutellum dark brown. Sides of thorax yellowish-grey with dark brown marks ; metanotum yellowish-grey.

Abdomen dark mahogany brown, hind borders of segments very narrowly yellowish ; belly greyish ; genitalia bright shining brown, basal part of lower valves dark brown.

Legs yellow ; coxae and trochanters marked with black ; a subapical moderately narrow black ring on femora.

Wings pale grey, with a darker pattern resembling that of *kempi*, especially on basal half. In the distal half it is broken up into smaller spots varying slightly in the individual. Halteres dark, clubs pale grey.

Described from two ♀ ♀ in the Indian Museum from above Tura, 3,500–3,900 ft., vii-17 (*Kemp*) : viii-17 (*Mrs. Kemp*), and one ♀ from Sureil, Darjiling District, 5,000 ft., 11—31-x-17 *type* (*Annandale* and *Gravely*).

Section *ANISOMERINI.*

GYNOPLISTIA, Westw.

occipitalis, de Meij., *Nova Guin. Res.* IX, p. 310 ♂ (1915). Papua. The unique type in (?) Amsterdam Museum.

No type species appears to have been selected for this genus ; I therefore propose *Ctenophora vilis,* Walk., the first of the two species included by Westwood at the erection of his genus.

ERIOCERA, Macq.

The recent additions in new species to this genus have been very numerous yet probably very many oriental forms remain to be discovered.

ctenophoroides, Edw., *Ann. Mag. Nat. Hist.* (8) VIII, 64 ♂ ♀ (1911). Ceylon.

scutellata, *id., loc. cit.*, p. 65 ♂ ♀ (1911). Ceylon.

tuberculifera, *id., loc. cit.*, p. 66 ♀ (1911). Ceylon.

fusca, *id., loc. cit.*, p. 66 ♂ ♀ (1911). Ceylon.

Types of above four species in British Museum.

angustipennis, Enderl., *Zool. Jahr.* XXXII, 33 ♂ (*Physecrania*) (1912). Sumatra.

pannosa, *id., loc. cit.*, p. 40 ♂ ♀ (1912). Sumatra.

gamma, *id., loc. cit.*, p. 42 ♂ ♀ (1912). Sumatra.

sauteriana,[1] *id., loc. cit.*, p. 42 ♀ (1912). South Formosa.

paenulata, *id., loc. cit.*, p. 43 ♀ (1912). Sumatra.

Types of above five species in Stettin Zoological Museum.

rufithorax, Brun., *Fauna Brit. Ind. Dipt.*, p. 534 ♂ ♀ (1912) (pl. vii, fig. 10). Kandy.

tenuis, *id., loc. cit.*, p. 539 ♂ (1912). Nilgiri Hills.

aterrima, *id., loc. cit.*, p. 540 ♀ (1912). Travancore.

elongatissima, *id., loc. cit.*, p. 542 ♂ (1912). South India.

flavipes, *id., loc. cit.*, p. 544 ♂ (1912). Kurseong.

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[1] Edwards records from Kotosho Is., Formosa, 20-vii-12 (*Shiraki*) and from Arisan, Formosa, 8,000 ft., 10-x-12 (*Nitobe*).

testacea, *id., loc. cit.*, p. 548 ♀ (1912). Nilgiri Hills.

nigerrima, *id., loc. cit.*, App. p. 571 ♀ (1912), (pl. vii, fig. 16). Darjiling District.

triangularis, *id., loc. cit.*, App. p. 572 ♂ (1912). Nilgiri Hills.

Types of all species from *rufithorax* to *triangularis* inclusive in Indian Museum.

nigrina, Riedel, *Entom. Mitt.* II, p. 273 (1913). Kankao, Formosa ♂ ♀, vii-ix-1912. Type in Deut. Ent. Mus. Cotype in Riedel coll.

xanthopyga, de Meij., *Tijd. v. Ent.* LVI, Supp. p. 3 ♂ ♀ (Mar. 1914). Java.

unicolor,[1] *id., loc. cit.*, LVIII, Supp. p. 12 ♂ ♀, 1915 (1916).

simalurensis, *id., loc. cit.*, p. 13 ♂ ♀, 1915 (1916).

Both species from Sinabang, Simalur Island, off the west coast of Sumatra. Types in Amsterdam Museum.

rubriceps, Edw., *Ann. Mag. Nat. Hist.* (8) XVIII, p. 253 ♀ (1916). Taipin, Formosa. Unique type in British Museum.

lativentris, Bezzi, *Phil. Jour. Sci.* XII, Sect. D, p. 113 ♂ (1917). Luzon (*Baker*).

crassipes, *id., loc. cit.*; p. 114 ♂ ♀ (1917). Luzon (*Baker*).

In his paper on Javan Tipulidae Alexander notes the following five species: *E. verticalis*, W.; *acrostacta*, W., *basilaris* W., *mesopyrrha*, W., and *cingulata*, Meij. He also gives figures of the wings of the first two and the last one.

Eriocera verticalis, Wied.

Described as a *Megistocera*, from Java. The prominent vertex and frons forming a considerable bump at the top of the head renders this species conspicuous, especially in conjunction with the enormously produced antennae, which are about three to three and a half times as long as the whole body. It is excellently figured by Van der Wulp (*Tijd. v. Ent.* XXXVIII, pl. ii, fig. 6, 7). One ♂ from Bageshwar, Kumaon District, 3,500 ft., 25-v-09 (*A. D. Imms*), and one ♂ from Pusa Bihar, at light, 10-ix-15, the latter in the Pusa collection.

Eriocera cingulata, Brun.

(Plate vii, fig. 7.)

This species, described by me in the Fauna volume, App. 570 ♂, (1912) must be renamed, owing to *E. cingulata*, Meij. The name *cincta* is therefore proposed.

Riedel (*Ent. Mitt.* II) records *E. nigripennis*, Meij. and *E. sauteriana*, Ender. from Formosa.

Eriocera flavipes, Brun.

(Plate vii, fig. 15.)

A ♂ from Sureil, Darjiling District, 5,000 ft., iv-v-17 (*Kemp*) is probably this species. The tibiae are yellowish-brown; the posterior

[1] Edwards records from Horisha, Formosa, 1,000 ft. (*Maki*).

cross vein is at the middle of the discal cell in one wing and near the base in the other. There are traces of gold dust spots towards the sides of three of the middle abdominal segments and I am not altogether satisfied with the identity.

Table shewing general grouping of oriental species of ERIOCERA.

A. Thorax mainly or wholly yellow or reddish, as compared with black or brownish.[1]	
B. Abdomen principally yellowish or reddish	
C. Wings dark, without distinct pale markings.	
(*a*) Five posterior cells	*plecioides*, Walk., *angustipennis*, Ender., *aurantia*, sp. nov. *nigroapicalis*, sp. nov.
(*b*) Four posterior cells	*pachyrhina*, Os. Sac., *rubrescens*, Walk., *pyrrhochroma*, Walk. *paenulata*, Ender.
(*c*) Number of posterior cells unstated . .	*scutellata*, Edw.
CC. Wings dark, always with distinct pale markings	*acrostacta*, Wied., *mesopyrrha*, Wied., *lunata*, Westw., *combinata*, Walk., *diluta*, Walk., *badia*, Brun.
BB. Abdomen principally black or brown .	*infixa*, Walk., *selene*, Os. Sac., *humberti*, Os. Sac., *meleagris*, Os. Sac., *pannosa*, Ender., *ctenophoroides*, Edw., *fenestrata*, Brun., *rufithorax*, Brun.
AA. Thorax mainly or wholly black, blackish, brown or dark grey, as compared with yellowish or reddish (in *gravelyi* sometimes partly or wholly ferruginous red; in *pulchrithorax*, ash-grey).	
D. Abdomen principally yellowish or reddish.[2]	
E. Very small species, 6 mm.	*optabilis*, Walk.
EE. Larger species, 12 mm. upwards.	
(*a*) Five posterior cells	*bicolor*, Macq., *semilimpida*, Brun.
(*b*) Four posterior cells	*dichroa*, Walk., *albonotata*, Lw., *simalurensis*, Meij., *testacea*, Brun., *pulchrithorax*, sp. nov., *rufiventris*, sp. nov., *tripunctipennis*, sp. nov.
(*c*) Number of posterior cells unstated . .	*tuberculifera*, Edw.
DD. Abdomen principally blackish or brown; the ground colour never pale (in *maculiventris* dorsal surface mainly orange except at sides and tip).	
F. Wings absolutely clear	*crystalloptera*, Os. Sac.
FF. Wings dark, with or without pale markings.	
(*a*) Five posterior cells.	
G. Legs black or dark brown	*basilaris*, Wied., *leucotelus*, Walk., *mansueta*, Os. Sac., *unicolor*, Meij., *gravelyi*, sp. nov.
GG. Legs yellow	*perennis*, Os. Sac., *plumbicincta*, Brun.
(*b*) Four posterior cells.	

[1] The terms used in this table such as "mainly yellowish or reddish" must not be taken too literally, and allowance must be made for individual variation which is not uncommon in this genus.

[2] A considerable portion is yellowish in *bicolor*, *semilimpida* and *albonotata*.

H. Wings unmarked	*aterrima*, Brun.; *caliginosa*, sp. nov.
HH. Wings always with yellow or whitish markings.	
I. Very large species, 25 to 31 mm. . .	*tenuis*, Brun., *kempi*, sp. nov., *elongatissima*, Brun.
II. Species normally below 20 mm.[1] . .	
J. Legs yellow	*albipuncta*, Wulp., *greeni*, Brun., *flavipes*, Brun., *decorata*, sp. nov.
JJ. Legs black	*nepalensis*, Westw., *sumatrensis*, Macq., *gamma*, Ender., *sauteriana*, Ender., *rufibasis*, Brun.
(*c*) Number of posterior cells unstated . .	*verticalis*, Wied., *lunigera*, Walk., *morosa*, Os. Sac.,, *fusca*, Edw., *nigripennis*, Meij.

In the above table a fair amount of latitude must be allowed for, as it is only intended as a rough grouping of species on comparatively easy characters. If a more critical table be attempted, other and more important characters would be adopted. For easy reference it may, however, prove useful if the terms used are not construed too literally.

Eriocera aurantia, sp. nov.

♀. Darjiling. Long. 12 mm.

Whole body rich deep orange except tip of proboscis brownish and palpi black; flagellum of antennae brown with pale pubescence; frons rather prominent. Some indistinct and irregular brown markings on dorsum of abdomen. Legs dark brown except coxae rich orange and base of femora more or less yellowish.

Wings uniformly rather dark brown; no stigma; anterior cross vein at extreme base of discal cell; posterior cross-vein at middle of discal cell; 2nd posterior cell petiolate; 5 posterior cells; halteres, stems yellowish, clubs black.

Described from two ♀ ♀ in the Indian Museum from Kalimpong, 600–4,500 ft., 24-iv—10-v-14 (*Gravely*). What is probably an immature ♂ of this species is represented by a specimen from Darjiling, 7,000 ft 12-vi-14 (*Gravely*).

Eriocera nigroapicalis, sp. nov.

♀. Darjiling. Long. 12 mm.

Very like *aurantia* but quite distinct.

Frons very dark brown; proboscis, palpi and occiput black, with scattered hairs; antennae black, with grey reflections. Last four abdominal segments quite black, ovipositor orange. Legs black except about basal third of femora yellowish; tibiae dark brownish-yellow tinged.

Wings uniformly moderately dark brown; stigma distinct, rather large, black; 5 posterior cells. Anterior cross-vein at extreme basal corner of discal cell; posterior cross-vein barely reaching its lower corner as the 5th posterior cell is only in punctiform contact with the

[1] *Nepalensis* sometimes attains a length of 25 mm.

discal cell, the lower side of which is formed wholly by the bases of the 3rd and 4th posterior cells. 2nd posterior cell sessile. Halteres small, black.

Described from a unique ♀ in the Indian Museum from Kalimpong, 24-iv—10-v-14 (*Gravely*).

Eriocera pulchrithorax, sp. nov.

♀. Cochin. Extreme length to tip of ovipositor 18 mm.

Head wholly ash-grey, including scape. Proboscis and palpi blackish ; flagellum of antennae with two first joints yellowish, remainder black. Scape, frons and occiput with a few black hairs.

Thorax uniformly and wholly ash-grey, with black markings, distributed as follows. A pair of median narrow stripes, nearly contiguous, from anterior margin nearly to suture ; behind the suture a large oval spot on each callosity with a distinct round smaller one in front of each. A narrow line just below sides of dorsum ; a round spot on mesopleura ; a large oval transverse spot on hind margin of scutellum ; a large spot on each anterior corner of mesonotum, a small one on each posterior corner, with a narrow median line. All these spots black.

Abdomen.—1st joint black, remainder bright chrome yellow ; a narrow reddish hind margin to each segment ; last two segments deep velvet black ; ovipositor orange.

Legs.—Coxae ash-grey, remainder of legs brownish-yellow, tips of femora, of tibiae and of tarsi joints black.

Wings rather dark brown ; extreme tip narrowly white. Anterior cross vein near middle of discal cell, posterior cross vein towards its tip. Four posterior cells ; halteres black.

Described from a unique ♀ in the Indian Museum (middle legs missing) taken on the Forest Tramway, mile 10 to 14, 0—300 ft., Cochin State, 28—29-ix-14 (*Gravely*).

Eriocera rufiventris, sp. nov.

♂ ♀. Cochin. Long. 17 mm.

Head and *thorax* wholly black ; pleurae with slight grey reflections in certain lights ; antennae and palpi thinly pilose.

Abdomen.—1st segment black ; remainder wholly bright reddish-orange ; genitalia concolorous, hypopygium with black hairs ; 2nd joint of claspers long, black, hook-like ; ovipositor very long, bare.

Legs in ♂ black, coxae and about basal third of femora brownish-yellow ; in ♀ dark brownish-yellow, passing at first sight for blackish, tips of femora darker.

Wings moderately dark brown ; anterior cross vein at base of discal cell. Four posterior cells ; halteres nearly black.

Described from one ♂ and one ♀ in the Indian Museum from Parambikulam, Cochin State, 16—24-ix-14 (*Gravely*) ; and one belonging to Mr. Fletcher, taken by him at Coorg, S. India, 24-x—16-xi-15.

This species comes in my table next to *testacea* Brun.

Eriocera gravelyi, sp. nov.

(Plate vii, fig. 9.)

♂ ♀. Darjiling District and Assam. Long. 14 to (extreme ♀) 24 mm.

Head blackish-grey with short bushy hairs; proboscis shining black, labella dull yellowish at base; palpi and antennae black.

Thorax normally velvet black, including scutellum, metanotum and pleurae, the latter a little duller. Often ferruginous red from anterior margin of dorsum for a considerable distance or even the whole dorsum up to the scutellum, behind which the red is duller and less conspicuous. In some specimens with an all black thorax there is a trace of red sometimes visible if viewed from a low angle in front.

Abdomen velvet black; basal half of 2nd, 3rd, 4th and 5th segments and to a less extent the 6th and 7th segments with a shining steel band which is whitish on its hinder part. Genitalia in ♂ shining black, approximately normal; 1st joint of claspers with short grey hairs, 2nd pointed and curved; a small triangular hairy-tipped ventral style, and a small curved emarginate dorsal plate. In the ♀ basal half of ovipositor bright orange, the remainder shining dark brown.

Legs black or very dark brown, base of femora sometimes brownish.

Wings dark blackish-brown, with a slight violet tinge; both axillary cells distinctly paler. A rather large white spot just beyond the middle lying over both basal cells, and a small one in the marginal cell just above the origin of the 3rd vein. Extreme tip of wing with a small white spot extending over the tips of both submarginal cells and the 1st posterior cell. Marginal cross vein distinctly beyond fork of 2nd vein. Five posterior cells. Halteres black.

Described from several of each sex from Pashok, Darjiling District, 1,000–2,500 ft., 26-v—14-vi-16 (*Gravely*), and from ♂ ♂ and ♀ ♀ from Tura, Garo Hills, Assam, 1,200–1,500 ft., vi, vii and x-17 (*Kemp* and *Mrs. Kemp*).

Types in Indian Museum, cotypes in my collection.

Eriocera decorata, sp. nov.

(Plate vii, fig. 12.)

♂ Darjiling District. Long. 9 mm.

Head.—Frons and occiput yellowish-grey with stiff black hairs; proboscis and palpi blackish, labella yellowish at base. 1st scapal joint of antennae almost bluish-grey, 2nd joint and flagellum brownish-yellow with black pubescence.

Thorax blackish-grey, ash grey irregularly around margin of dorsum and sides of both scutellum and metanotum; pleurae mainly blackish-grey.

Abdomen blackish; basal half of 2nd and 3rd segments, 4th segment narrowly at base, 5th almost entirely, with grey dust, whilst on the 2nd and 3rd segments the anterior half of the grey band is almost steel-colour. Whole abdomen and belly with soft black pubescence,

Genitalia of moderate size, orange, a narrow dorsal and ventral emarginate plate, claspers apparently normal.

Legs.—Coxae and trochanters black; remainder brownish-yellow with short black pubescence; tips of femora broadly and rather gradually black; tips of tibiae and of first two tarsal joints very narrowly black, rest of tarsi black.

Wings.—Ground colour uniformly dark brown except base of 2nd axillary cell greyish. A large white spot placed just before discal cell, extending over both basal cells, reaching narrowly upwards into marginal cell and also narrowly downwards across anal cell. A smaller whitish spot in marginal cell just beyond marginal cross vein and extending slightly into the cell below. Marginal cross vein (which is very oblique and placed before fork of 2nd vein), anterior and posterior cross veins, and the inner and outer sides of discal cell suffused with yellowish, as is also extreme base of 2nd vein. A small whitish spot just beyond this latter one. A small whitish streak near base of wing from 1st vein, running diagonally across both basal cells. Four posterior cells. Halteres black.

Described from a single ♂ in the Indian Museum from Pashok, 2,000 ft., 26-v—14-vi-16 (*Gravely*).

Eriocera tripunctipennis, sp. nov.

♂ ♀. South-West India. Long. 13—15 mm.

Head.—Frons and occiput shining blue-black; proboscis brownish-yellow, black tipped; palpi and antennae black, scape of latter also extreme base of 1st flagellar joint orange.

Thorax, scutellum and metanotum shining deep blue-black with slight grey reflections. Lower edge of dorsum with a rather narrow deep velvet black margin which is shortly interrupted both behind the shoulder (where the black stripe turns distinctly upwards) and in front of wing base. Humeri and prothorax pale livid yellow. Sides of thorax black with more conspicuous bluish-grey reflections, especially on sternopleura.

Abdomen bright orange, 1st segment black on dorsum, remaining segments with narrow black band on posterior margin. Genitalia in ♂ orange, claspers black tipped; in ♀ reddish-brown, tip shining black, the extreme points orange.

Legs.—Coxae orange, base blackish with bluish-grey reflections; femora yellowish at base gradually darkening to black at tips, tibiae and tarsi black.

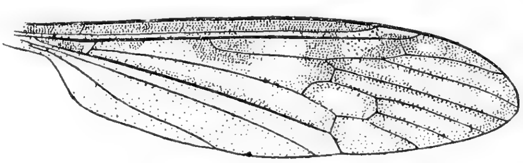


FIG. 7.—Wing of *Eriocera tripunctipennis,* sp. nov.

Wings rather dark grey; four posterior cells; all the veins except 6th and 7th narrowly suffused a little darker; costal cell blackish, a

row of three distinct moderate-sized subequal darker spots placed (1) on base of 2nd longitudinal vein, (2) over marginal cross vein and (3) an intermediate one which is sometimes extended downwards along basal sides of cells as far as 4th longitudinal vein. Distal side of discal cell and posterior cross vein also suffused. Halteres black.

Described from a ♂ and two ♀♀ in the Indian Museum. Castle Rock, 11—26-x-16, *type* ♂; Talewadi, 3—10-x-16, *type* ♀ and second ♀, (both N. Kanara District; *Kemp*).

Eriocera caliginosa, sp. nov.

♀. South-West India. Long. 9—10 mm.

Head blackish-grey; palpi black; scape of antennae blackish; flagellum dark brown.

Thorax wholly black, moderately shining; metanotum with very dark brown tinge.

Abdomen black, 1st segment with transverse white basal stripe; 3rd and 4th segments with more than basal half of each yellowish, except at sides. Genitalia black.

Legs wholly black.

Wings moderately blackish; four posterior cells; halteres black.

Described from two ♀♀ in Indian Museum from Talewadi, near Castle Rock, N. Kanara District, 3—10-x-16 (*Kemp*).

Eriocera kempi, sp. nov.

♂ ♀. South-West India. Long. 25—34 mm.

Head blackish-grey with a deep black band on inner side of eyes, extending over the moderate-sized frontal gibbosity. Proboscis, palpi and antennae black, shortly pubescent, mouth parts sometimes a trifle paler.

Thorax wholly velvet black, a pair of moderately broad closely approximate barely discernible median stripes and also the mesonotal swellings just perceptibly less deep black anteriorly. Sides of thorax dull black, with dark grey reflections in certain lights. Scutellum and metanotum velvet black.

Abdomen, ♂: velvet black; basal third to a half of 3rd segment, and basal half of 4th and 5th segments bright chrome yellow. In the only ♀ present the first yellow band is absent. Genitalia black, moderately shining, small; tip of ovipositor reddish-brown.

Legs all black, microscopically pubescent.

Wings moderately deep blackish; four posterior cells; extreme wing tip whitish; halteres black.

Described from several ♂♂ and a single ♀ in the Indian Museum from Castle Rock, N. Kanara District, 11—26-x-16 (*Kemp*).

An exceedingly handsome species and one of the largest known from the orient.

Eriocera maculiventris, sp. nov.

(Plate viii, fig. 18.)

♂ ♀. Assam. Long. ♂ $12\frac{1}{2}$, ♀ 15 mm. to tip of ovipositor.

Head blackish-grey with stiff black hairs; proboscis, palpi and antennae blackish, tip of 2nd scapal joint narrowly pale; flagellum black pubescent.

Thorax all black, slightly shining, black pubescent, traces of grey dust on sternopleura.

Abdomen black; dorsal surface of 2nd, 3rd, 4th and 5th segments mainly orange, the colour occupying basal half of 2nd segment except at sides, and the whole of the 3rd, 4th and 5th segments except for a moderately narrow hind border and side margins. In some specimens the orange colour fills nearly all the dorsal surface of all four segments. Genitalia in ♂ black, pubescent, of moderate size; in ♀ orange, apical half shining brown. Belly black, 3rd and 4th segments considerably orange.

Legs black.

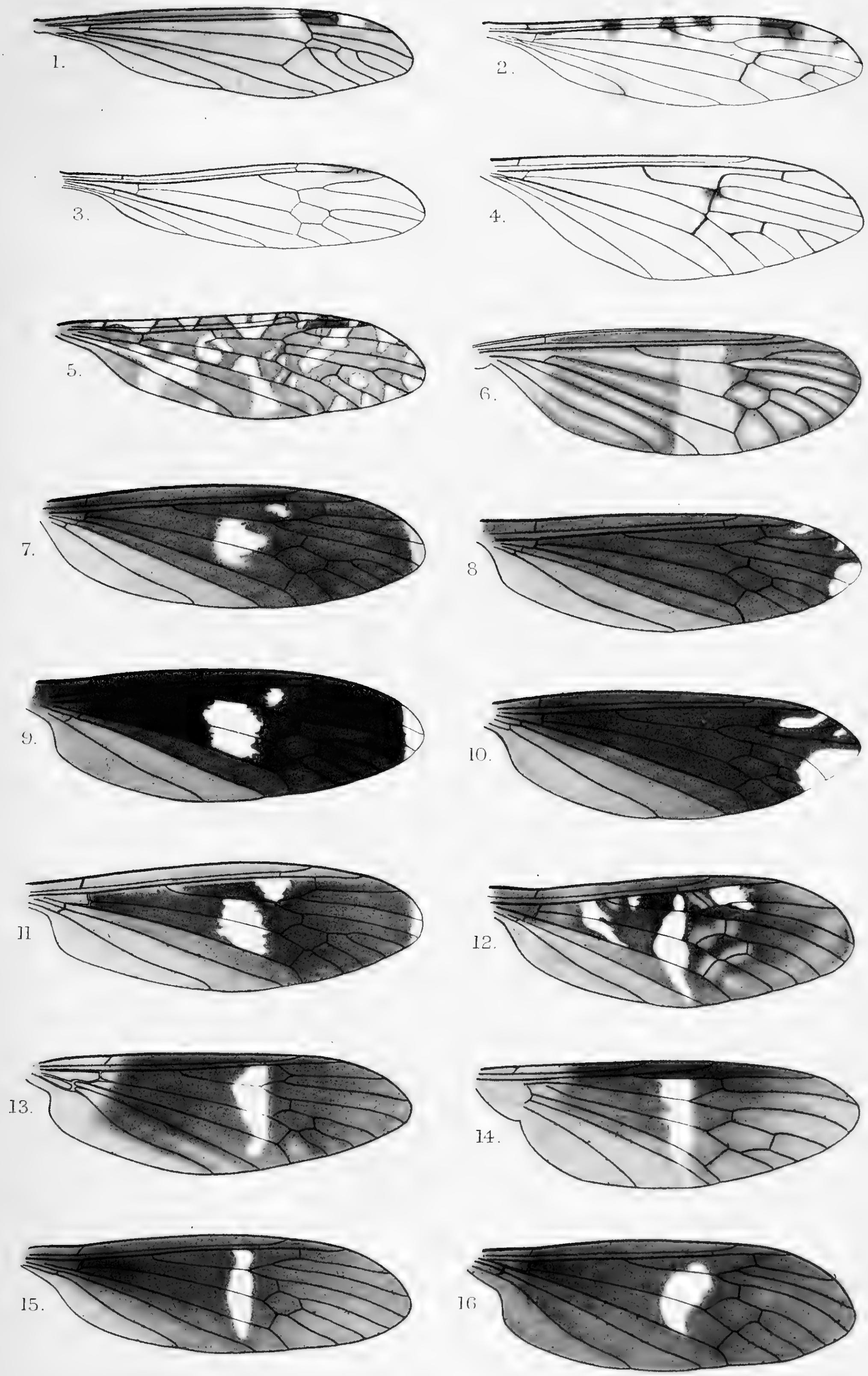
Wings blackish, central part, beginning with marginal cell and extending without definite outline to hind margin, clearer, the pale part limited irregularly by the "cross veins." Traces of a very narrow whitish longitudinal streak in 2nd submarginal and 1st posterior cells. Five posterior cells. In ♀ the pale part more extensive, spreading over major part of hinder half of wing. Halteres black.

Described from seven specimens in the Indian Museum, from Tura, Garo Hills, 1,200–1,500 ft., vii-17 and above Tura, 3,900 ft., vii, viii, x-17 (*Kemp* and *Mrs. Kemp*).

This must be near *perennis*, Os. Sac. by the orange abdominal bands but it differs by the black antennae, the black ultimate abdominal segment in the ♀, and the black femora and tibiae. In *perennis* also the wing is yellowish at the base and has a yellowish-white cross band.

EXPLANATION OF PLATE VII.

Fig. 1.—*Nesopeza albitarsis*, sp. nov., wing.
,, 2.—*Geranomyia flaviventris*, sp. nov., wing.
,, 3.—*Rhamphidia abnormalis*, sp. nov., wing.
,, 4.—*Amalopis spectralis*, sp. nov., wing.
,, 5.—*Limnophila ornatipennis*, sp. nov., wing.
,, 6.—*Eriocera bicolor*, Macq., wing.
,, 7.—*E. cincta*, nom. nov. (*cingulata*, Brun. preocc. De Meij.), wing.
,, 8.—*E. greeni*, Brun., wing.
,, 9.—*E. gravelyi*, sp. nov., wing.
,, 10.—*E. rufithorax*, Brun., wing.
,, 11.—*E. plumbicincta*, Brun., wing.
,, 12.—*E. decorata*, sp. nov., wing.
,, 13.—*E. nepalensis*, Westw., wing.
,, 14.—*E. sumatrensis*, Macq., wing.
,, 15.—*E. flavipes*, Brun., wing.
,, 16.—*E. nigerrima*, Brun., wing.



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ORIENTAL TIPULIDÆ

EXPLANATION OF PLATE VIII.

FIG. 1.—*Xiphura indica*, sp. nov., antenna.

,, 2.—*Pselliophora flavofasciata*, sp. nov., abdomen in profile.

,, 3.—*Id.*, wing.

,, 4.—*Tipula serricornis*, Brun., base of antennae.

,, 5.—*Id.*, sp. nov., idem.

,, 6.—*Dolichopeza costalis*, sp. nov., wing.

,, 7.—*Limnobia marginata*, sp. nov., wing.

,, 8.—*L. 5-notata*, sp. nov., wing.

,, 9.—*L. tritincta*, sp. nov., wing.

,, 10.—*Gymnastes pennipes*, sp. nov., hind leg.

,, 11.—*Teucholabis angusticapitis*, sp. nov., head and thorax, dorsal view.

,, 12.—*Id.*, head in profile.

,, 13.—*Id.*, tip of proboscis.

,, 14.—*Limnophila flavipennis*, sp. nov., wing.

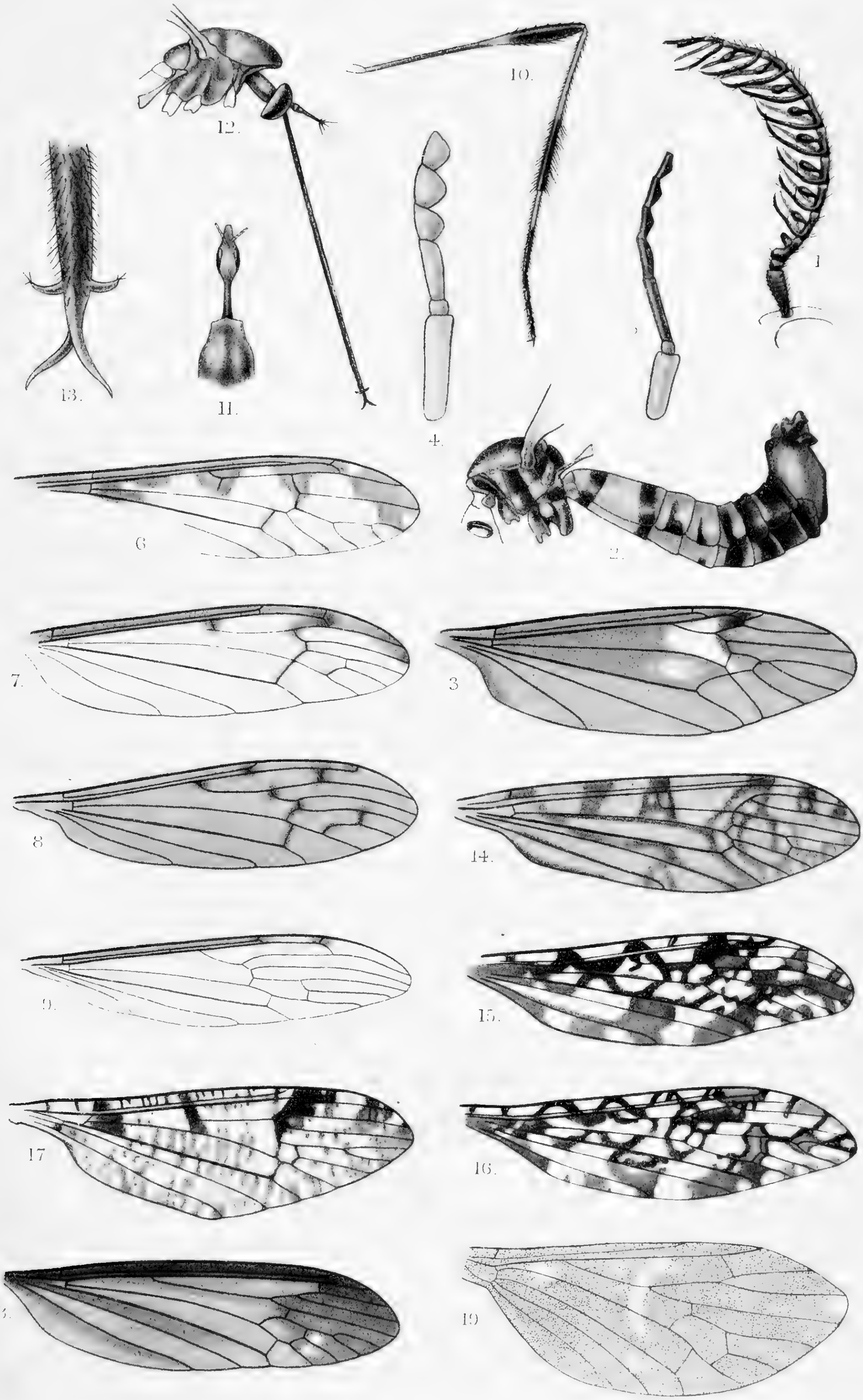
,, 15.—*Epiphragma vicina*, sp. nov., wing.

,, 16.—*E. klossi*, sp. nov., wing.

,, 17.—*Dicranophragma multipunctipennis*, sp. nov., wing.

,, 18.—*Eriocera maculiventris*, sp. nov., wing.

,, 19.—*E. acrostacta*, Wied., wing.



ORIENTAL TIPULIDÆ.

XXIII. NOTES FROM THE BENGAL FISHERIES LABORATORY.

No. 5. PARASITES OF INDIAN FISHES, WITH A NOTE ON CARCINOMA IN THE CLIMBING PERCH.

By T. Southwell, *A.R.C.Sc.* (*Lond.*), *F.Z.S., Director of Fisheries, Bengal and Bihar and Orissa, and Honorary Assistant, Indian Museum ; and* Baini Prashad, *M.Sc., Superintendent of Fisheries.*

(Plates X-XIV.)

CONTENTS.

Introduction.

With the exception of the first part, describing a carcinoma in the climbing-perch, the following paper deals with a variety of parasites of Indian fishes. All the material was collected in the latter half of the year 1917 and the early part of the year 1918, except the Trematoda described.

I. ON THE OCCURRENCE OF COLLOID CARCINOMA ON THE BODY OF THE CLIMBING-PERCH (*ANABAS SCANDENS*, DALD.).

Plate X.

1. *Introduction.*—During April, 1917 investigations relating to the breeding habits of various fishes were made by the Department, in certain *beels* in the Khulna district, Bengal. On May 4th, 1917 a number of young specimens (about 70) of the climbing-perch (*Anabas scandens*, Dald.) roughly 1 cm. long were collected from a *beel* and brought to Calcutta. These were kept in an aquarium. No care whatever was taken of them. Between May 4th and the beginning of October the water in which the fish were placed was only changed once. The specimens were not fed except on five or six occasions when the office attendant casually threw in a handful or so of parched paddy (*khai*). By the beginning of October only twenty fish remained, the rest having died and been eaten by the survivors. They had then grown to a length of 14 centimetres. About the beginning of August, it was noticed that two of the fish had developed conspicuous outgrowths on various parts

of the body. On October 10th three fish were found to be affected. These were preserved. The present account deals with the nature and structure of the outgrowths noted above. Observations on the remaining 17 fishes, which are still living under the same conditions (April 1st), are being continued.

2. *Technique.*—The outgrowths were cut off from one of the living fish and preserved in corrosive acetic solution. This fish, along with the two others, was preserved in 90 per cent. alcohol. One of the outgrowths was teased out and permanently mounted in dilute glycerine. Sections of the tumour were also cut with a Minot's microtome by the ordinary paraffin method. These were stained with Heidenhain's iron haematoxylin followed by eosin.

3. *Appearance and occurrence.*—The outgrowths are remarkable in having a mulberry-shaped appearance. They are much divided, nodular masses (fig. 4) attached to the body of the fish by very short stalks. They vary considerably in appearance and occur in various situations. In one fish two masses were present on the left side, one attached a little above the operculum and the second about half an inch in front of the first (fig. 1). A very small one was developing below the eye, whilst a fourth was present on the mid-ventral line in the region of the throat.

In the second specimen (fig. 2), a large outgrowth had developed above the right eye. A similar but very much smaller one was present over the left eye. A third was to be seen on the right side, about half an inch behind the eye. A small outgrowth was hanging pendant from the upper jaw on the right side; another from the lateral edge of the operculum on the right side. A small one was also present on the fin-rays of the ventral fin.

In the third fish (fig. 3) the main outgrowth was on the tip of the snout. A smaller one was attached to the ventral edge of the operculum, on the ventral side, near the throat. Another was situated a little in front of the pelvic fins, whilst still another large outgrowth was to be seen on the base of one of the spines of the dorsal fin. Another small one was also present on the upper margin of the caudal fin.

4. *Structure.*—The tumours are undoubtedly infiltrating epithelial neoplasms, or malignant epitheliomas, designated as Carcinomas by Orth. They are of an alveolo-tubular type, the greater proportion of these being solid. On teasing out a portion of the tumour it is seen to consist of large polygonal cells filled up almost entirely with large numbers of small glistening drops of colloid substance. The nuclei of these cells could not be distinguished in the glycerine mounts. They were, however, seen in the stained sections. The greater portion of the carcinoma is of a regular formation. The epithelium is closely packed, but very extensively vacuolated. Here and there, particularly where the outgrowths arise from the external surface, we find that the alveoli have coalesced to form large tubular cavities. These tubular cavities are lined by epithelium which also is vacuolated. Around the vacuoles, colloid material can be seen as deeply staining granules filling up the rest of the epithelial cells. The core of these wart-like outgrowths consists of connective tissue; pigment corpuscles are present both in the connective tissue and in the epithelial cells,

5. *General considerations.*—A summary of the history of this disease amongst fishes, and the literature relating thereto, has already been given by one of us (2) and need not therefore be recapitulated. These tumours do not occur in fishes living under natural conditions. They only arise when fish are placed under artificial surroundings, such as occur in aquariums and hatcheries. These artificial conditions react on the fish in such a way that anomalous tissue, of thyroid nature, arises, either as a single tumour (as in trout), or a series of tumours (as in the climbing-perch). It is impossible to say whether these tumours are derived directly from the cells of the thyroid gland or not. A specific organism is suspected, but as yet no such organism has been isolated.

The tumours from the climbing-perch described above differ in certain respects from similar tumours described by other writers from other species of fish.

The colloid carcinomas recorded up to the present are rounded structures with smooth surfaces. Ours, as we have pointed out, may present the appearance of a series of closely approximated nodules, attached to each other, and to the body of the fish, by a short stalk. In other cases the surface of the tumour is rugose and the nodular appearance is less distinct. Quite young tumours are flattish or mushroom shaped.

The colloid carcinoma described by one of us (2) from a trout caught in the Punjab was enclosed in a tough fibrous capsule or cyst. The ones described from the climbing-perch are not encapsuled but merely covered with epithelium. It is clear, therefore, that the tumours may either be encapsuled or not, in accordance probably with their point of origin. Gaylord and Marsh (1) in discussing anomalous deposits of thyroid nature in fishes state that: "as the thyroid is a somewhat diffuse organ one might expect to find instances of remotely placed deposits. We are therefore surprised to find the sharp delimitation to the region already described which appears to exist in our wild specimens, with one marked exception, *i.e.*, the jugular pit to which reference has already been made. It has been assumed by some writers that aberrant thyroid deposits in some region might be frequently expected. This has been due to the development of tumour nodules in regions beyond the normal and usual seat of distribution, such as the lower mouth parts and gill arch region. The only outlying tumours of this sort which may be inferred with certainty to arise from original deposits of thyroid are the so-called pit-tumours."

The observations made on the tumors found in the climbing-perch show that thyroid deposits may occur anywhere in the fish, as internal or external growths. It is, however, impossible to decide at present whether such thyroid deposits are original or secondary.

It will be obvious that in the climbing-perch, the tumors being disposed as masses of tissue over the surface of the body, it is not impossible in some cases for the fish to remove them by rubbing the affected part against a solid substance. The tumors are, however, somewhat firmly attached. Whether removal in this manner would invariably result in spontaneous recovery may be doubted, since the tumours in question have a deep-seated origin.

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1. Gaylord, H. R. and Marsh, M. C.—*Carcinoma of the Thyroid in the Salmonoid fishes.* Institute for the study of Malignant diseases. Serial No. 99. Washington, 1914.
2. Southwell, T.—Notes from Bengal Fisheries Laboratory. Indian Museum, No. 2. On some Indian parasites of fish with a note on Carcinoma in Trout. *Rec. Ind. Mus.*, Vol. XI, Part IV, No. 16, August, Calcutta, 1915.

II. ON SOME INDIAN MYXOSPORIDIA.

Plate XI.

Except for a short note on a species of *Myxobolus* by one of us (9) practically nothing is known about the Indian Myxosporidia. Whilst working out the collections made by the Bengal Fisheries Department during the last few months we found three new species of the genus *Myxobolus*, Bütschli. Two of the species are unicapsulate forms, whilst the third is bicapsulate. A short note on another Myxosporidian of the genus *Sphaerospora*, Thélohan, in the collection of the Zoological Survey of India, is also included here.

Myxobolus rohitae, sp. nov.

This interesting parasite was found infesting the gills of *Labeo rohita* (Ham. Buch.). The fishes in question were caught in the Turag river at Mirpur, district Dacca, on the 2nd of June, 1917. A second lot of specimens was obtained on the 22nd of January, 1918. Unfortunately no observations were made on the living material, but well preserved specimens of the gills have enabled us to make a fairly complete study of the parasite. The infection was of a very heavy nature, involving all the gills of the fish in question, and, as will be seen from fig. 1, the cysts were scattered all over the surface of each of the gills. In one case 53 such cysts were counted on one surface of a single gill. The infection was equally severe over the rest of the gills of both the right and left sides.

Serial sections of the cyst, 3 to 4 μ thick, were cut by the ordinary paraffin method, and stained with Giemsa's solution, or Heidenhain's iron haematoxylin, followed by eosin. Besides sections, cysts were dissected and the spores thus removed were examined unstained, and also stained with Giemsa's solution. The sections of the cysts were found to be quite satisfactory and showed all the necessary stages.

The cyst (fig. 1).—The cysts preserved in spirit are of a creamy-yellow colour, measuring 3·1—3·8 mm. long and 0·8 —1·2 mm. broad. They lie with the long axis of the cyst parallel to the gill-filaments. The cyst varies in shape from oval to cylindrical. The ends are rounded while the surface attached to the gill-filaments is flattened. The infected gill-filaments were in no way specially enlarged or different from the other gill-filaments.

The wall of the cyst is formed of a vertically striated portion showing no nuclei. This part takes up the cytoplasmic eosin-stain only. It is covered externally by an epithelium two to three layers thick. Internal to the vertically striated portion of the cyst there is the endoplasmic layer. The layer shows a coarse granular structure ; the nuclei, which lie scattered in the cytoplasm, are either round or elongated, and measure 3 to 5 μ in length. No cell limits could, however, be discovered.

In all the cysts examined, spore formation had already proceeded to an advanced stage, and it was clear that the whole of the cavity in the middle of the cyst was occupied by mature spores, whilst the pan-sporoblasts and the immature spores were lying round the periphery. In many cases these pan-sporoblasts were seen lying amongst the nuclei of the endoplasm.

Formation of the spores.—In the endoplasm two sorts of nuclei are to be seen, *viz.*, the vegetative and the generative. The latter always occur in rounded cells, which have been variously designated as " sphères primitives " by Thélohan, " pan-sporoblasts " by Gurley, and " Propagation Zellen " by Keysselitz. They are, as has been described above, of a rounded shape, with a marginally situated nucleus (figs. 2-4). These cells vary in size from 6 to 11 μ, and, in the nucleus, a distinct caryosom can easily be distinguished. The pan-sporoblasts were in all cases seen to divide mitotically into two (figs. 5-9). In this particular the present species differs from *Myxobolus toyamai*, Kudo, where the pan-sporoblasts divide into two or three daughter cells. In the division of the pan-sporoblasts, the chromatin was seen first to form a coiled thread, which later on splits up by mitosis into two parts, one for each of the daughter cells. The next stage that occurs is one in which two cells are united together (fig. 10). These cells are the micro- and macro-gametes, a fact which is evident from the size of the cells. No separate micro- or macro-gametes were found. The next stage in the union of these two cells is the formation of a sinuous chromation thread in the nucleus of the macro-gamete (fig. 12). The nuclear membrane of the micro-gamete was next seen to disappear. At the same time the nucleus of the macro-gamete showed a chromatin thread, and in the next stage two chromatin spiral threads were to be seen, lying in the cytoplasms of the micro- and macro-gametes respectively. Each of these chromatin threads splits up into two, and four nuclei, two large and two small, are formed in the united cystoplasmic substance of the micro- and macro-gametes (figs. 13-17). In our preparations the next stage seen is a pan-sporoblast cell with five fully formed nuclei, surrounded by definitely marked cystoplasmic areas, and a large chromatin mass lying free (fig. 18). In the final stage ten fully formed nuclei can be distinguished in the mother pan-sporoblast, besides two nuclei for the pan-sporoblast mother cell, and reduction nuclear chromatin particles lying free in the cystoplasm of the mother cell. Intermediate stages are also present. The pan-sporoblast next divides into two daughter cells or sporoblasts, each with five nuclei ; two of these unite later on to form the nucleus of the sporoplasm portion of the spore, the one which is seen lying close to a vacuole forms the nucleus for the polar capsule and the other two

are for the spore membrane. Thus the transformation into the adult spore is brought about (figs. 24-25).

Structure of the spore.—A fully formed spore is an elongated pear-shaped body, rounded at the posterior extremity and acutely pointed anteriorly (fig. 26). It is symmetrical bilaterally, but not antero-posteriorly. The size of the spore varies from 30 to 32 μ in length, and from 7 to 8 μ in breadth. The spore-wall is formed of two valves; the point of junction of these valves is distinctly thickened, and can be seen, in a side view, as a slightly raised ridge. The ridge lies parallel to the long axis of the spore. Only one polar capsule is present in each spore. It is of a large size, 22 to 23 μ in length, and has the same shape as the parent spore. In the polar capsule a much coiled thread can be easily seen, as also the opening of the duct for the extrusion of the thread or polar filament at the anterior pointed extremity of the capsule and the spore (fig. 27). The length of the polar filament, in the spores measured, varied from 92 to 97 μ. The nucleus of the capsulogenous cell is seen lying at the periphery of the polar capsule, on one side, near the posterior extremity, as an elongated body. In the protoplasm of the spore itself an iodinophilous vacuole, 3·6 μ in diameter, is present. Lying just posterior to it is the nucleus of the spore. A few granules of chromatin were also seen lying scattered in the protoplasm.

Systematic position.—From the preceding description it will be clear that our form is a Myxosporidian. Following Labbe's classification it falls in the Family Myxobolidae, and the genus *Myxobolus*, Bűtschli, in having bilateral symmetry and a bi-valve shell, with the valve junction plane parallel to the long axis of the spore, and further in having an iodinophilous vacuole in the protoplasm of the spore, and a single polar capsule at the anterior end.

The species of this genus are grouped under two heads, *viz.*, one with a single and the other with two polar capsules. So far, only five unicapsulate species of the genus *Myxobolus* have been recorded. These are :—

M. piriformis, Thélohan.
M. unicapsulatus, Gurley.
M. fuhrmanni, Auerbach.
M. oculi-leucisci, Trojan.
M. toyamai, Kudo.

Our form, like *M. piriformis* and *M. toyamai*, occurs on the branchiae, and differs in this respect from the other three unicapsulate forms. Compared with all the previously described unicapsulate forms our species is a very large one. The size of the cyst, the spore, and the polar capsule is much larger than in any of the other forms, and these are the characters on which the classification is chiefly based. The shape of the spore slightly resembles that of *M. toyamai*, though the anterior extremity of the spore, instead of being attenuated, is sharply pointed. Calabash-shaped spores, recorded from *M. toyamai*, are not present in our species. For these reasons we consider the present form to be a new one, and have called it *Myxobolus rohitae* after the name of the host.

Habitat.—The gills of *Labeo rohita* (Ham. Buch).

Turag river, Mirpur, Dacca district, Bengal, June, 1917. Numerous cysts.

Type specimens in the collection of the Zoological Survey of India (Indian Museum), Calcutta, numbered P $\frac{48}{1}$.

Myxobolus seni, sp. nov.

Cyst (Fig. 28.).—Elongated, ellipsoidal, varying in length from 4·7 mm. to 5·4 mm. by 2·9 to 3·7 mm. in breadth. Whitish with black scattered granules on the surface.

Spore (Figs. 29-31.).—Body oval, much wider behind than in front and pointed at the anterior end. The size of the spore varies from 13·2 μ—13·6 μ in length and 10·1 μ—10·3 μ in breadth. The spore wall is formed of two valves, the point of junction of these valves is slightly thickened as seen in a side view. There is a single polar capsule about 4 μ long; in it there is a much coiled polar filament, which in one case measured as much as 43 μ in length. Iodinophilous vacuole measuring 2·3 μ is also to be seen.

Habitat.—On the median and caudal fins of *Labeo rohita* (Ham. Buch.) Mirpur, Dacca, 22nd January 1918.

Type specimens in the collection of the Zoological Survey of India, Calcutta, numbered P $\frac{53}{1}$.

Remarks.—This species differs very remarkably from the other species described in this paper as *M. rohitae*, in the spores being of a much smaller size, while the cyst is much larger. It differs from all previously described unicapsulate forms in the shape and size of the cyst, the spore and polar capsules.

Myxobolus nodularis, sp. nov.

Cyst (Figs. 32 and 33.).—Rounded or slightly elongated, varying in length from 3·5—3·8 mm. and 2·3—2·8 mm. in breadth. Creamy yellow in colour, in one case appearing blackish owing to the large number of black granules scattered in its surface.

Spore (Figs. 34-36.).—Ovoidal. The size of a spore is 9 μ by 7·2 μ. The spore wall is formed of two valves, and the junction of the valves is very thick, as is seen in a lateral view of the spore. There are two capsules of equal size, measuring 3·4 μ in length. The polar filament in each of the capsules is very much coiled. In a spore in which the filaments were extruded, they measured 18·3 μ in length.

Habitat.—In the muscles of *Rasbora daniconius* (Ham. Buch.) occurring in two fishes on the sides, and in another as a globular cyst near the anus. Mirpur, Dacca, 7th June 1917.

Type specimens in the collection of the Zoological Survey of India, numbered P $\frac{52}{1}$.

Sphaerospora sp.

We would here record the occurrence of a species of *Sphaerospora*, Thélohan, from Burma. The poor condition of the material did not allow of a complete account of its structure, but the bicapsulate, rounded structure of its spores places it undoubtedly in the genus

Sphaerospora, Thélohan. The cysts occurred in very large numbers, one under each scale. They were found on a specimen of *Barilius barna* (Ham. Buch.) collected in June 1915, by J. Coggin Brown, Esq., of the Geological Survey of India, from the vicinity of the Ruby Mines, Burma.

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III. SOME FISH TREMATODES.

(Plate XII.)

We here describe a new species of the genus *Clinostomum*, Leidy. A small collection of encysted larval Trematodes is also described.

(*a*) **Clinostomum piscidium,** sp. nov.

Introduction.—The specimens dealt with in this communication were first collected from the mesentery of *Trichogaster fasciatus*, on April 16, 1915, at Khulna, Bengal. Since then specimens have been obtained from the mesentery of *Nandus nandus* [1] (May 1917),

[1] *Nandus marmoratus* of the "*Fauna of British India*."

from the same place. On the latter occasion it was found that they were quite common in *T. fasciatus* as well. The specimens were found to be moving freely on the mesentery and were not encysted.

They are flat semi-oval worms (fig. 1), varying in size from 2·8 mm.—5·2 mm. in length by 1·4 mm.—1·8 mm. in breadth. The body is compressed, with a small circular sucker (*s.i.*) at the anterior end, and a much larger spherical sucker-like acetabulum (*s.ii.*) behind the anterior one. The mouth-opening lies within the anterior sucker. There is no pharynx. The alimentary canal is forked, the intestinal caecae (*Int.*) reaching the posterior extremity. These intestinal caecae shew short lateral projections on both sides. The excretory pore (*E. O.*) is situated at the extreme posterior end, connected with a triangular excretory vesicle (*E. v.*), which lies behind the genital organs. The gonads lie in the middle third of the body. The testes (T) are roughly pyriform structures with the margins slightly indented, the anterior testis is much larger than the posterior one. From the end of each of the testis the tubular vas deferns (*v. d.*) leads to the base of the large cirrus sac (*c. s.*) situated alongside the anterior testis; the two vasa deferentia here unite to form the slightly swollen vesicula seminalis, which is only the beginning of the much coiled tube lying in the cirrus-sac; the end portion of this tube—the ejaculatory duct—leads into the genital atrium (*G. a.*). The ovary (*ov.*) is an ovoidal structure, with entire margins, lying in between the two testes. From the ovary a thin tubular oviduct after making several loops in the space between the two testes, and receiving a duct from the yolk receptacle, is continued in a straight upward course outside the anterior testis, and then curves inwards to open into the uterus. The uterus (*ut.*) which is a large structure lying in the middle line, and extending anteriorly up to the lower margin of the posterior sucker (*s. ii.*), is constricted posteriorly to open into the genital atrium. The genital atrium (*G. a.*) lies near the anterior edge of the cirrus-sac receiving in its cavity the openings of both the male and the female ducts. The genital pore (*G. P.*), or the opening of the genital atrium, lies in the middle line about the middle of the animal.

The vitelline glands (*v*) lie scattered on the two limbs of the intestine. The vitelline duct (*Vt. d.*) comes from the yolk glands and is seen to be formed of a number of fine branches, the ducts from the two sides meet in the middle to form a sac-like yolk receptacle, which as stated above opens into the oviduct.

A nerve collar (*N. C.*), with two nerves running posteriorly from it, can be seen surrounding the alimentary canal, just before forking takes place.

The hermaphrodite nature of the worm, the two suckers, the position of the acetabulum, the situation of the ovary between the two testes (which are non-digitate), the genital pore being situated posterior to the acetabulum, and the intestine having short lateral projections, place the worm undoubtedly in the genus *Clinostomum*, Leidy (4). The present species, however, differs from all previously described species, and we therefore name it *Clinostomum piscidium*, sp. nov.

Habitat.—The mesentery of *Trichogaster fasciatus*, Bl. Schn., also found on the mesentery of *Nandus nandus* (Cuv. and Val.), Khulna, district Khulna, Bengal, April 1915, and May 1917. Numerous specimens; types in the collection of the Zoological Survey of India (Indian Museum), No. W $\frac{58}{1}$.

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(*b*) ON A SMALL COLLECTION OF ENCYSTED LARVAL TREMATODES OF SOME INDIAN FISHES.

This is a record of the occurrence of encysted cercaria, of five different types, found in various situations in some of the commoner Indian fishes. As the sexual organs were not developed, and as the whole classification of the adult Trematodes is based on the disposition of the generative organs, we are unable to identify them further than to say that they belong to the family Distomidae. The larval characters on which the classification of the redia has been attempted by Lühe (3) and by Lebour (2) do not help in further elucidating the situation of these forms. The classification, according to Lühe, all depends on the different forms assumed by the tails. Lebour's classification depends, on the other hand, on whether the cercariae develop in sporocysts or in redia. As will be clear both these classifications are extremely artificial and are not, in most cases, of much assistance in identification, particularly of encysted forms; in such cases the tail of the cercaria is dropped before encystment and the adult characters have not as yet developed. At the same time we know nothing as to whether the cercaria were developed in sporocysts or in redia.

In all our forms we can distinguish the anterior sucker, and an acetabulum lying near the anterior end on the ventral surface. The alimentary canal is bifurcate and ends blindly, posteriorly. No spines are present. In one of the forms an excretory vesicle is to be seen. From these characters it is obvious that all the forms belong to the Distomidae. We append herewith a table showing the fish-hosts, the size of the parasites, and the situation where found.

Host.	Organ where encysted.	Size.	Locality.
Saccobranchus fossilis, Bloch.	Lateral muscles .	0·5 mm. by 0·17 mm. (Fig. 2).	Beel Kola, Khulna, Khulna district, 17th April, 1915.
Ophiocephalus marulius, Ham. Buch.	Wall of intestine .	1·2 mm. by 0·3 mm. (Figs. 3 and 3*a*).	Do.
Ophiocephalus striatus, Bloch.	Lateral muscles .	4·1 mm. by 1·7 mm. (Fig. 4).	Do.
Do. . .	Do. . .	6·2 mm. by 3·6 mm. (Fig. 5).	Do.
Trichogaster fasciatus, Bl. Schn.	Do. . .	1·3 mm. by 0·6 mm. (Fig. 6).	Khulna market, Khulna district, 16th April, 1915.

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IV. NOTE ON *DISCOCEPHALUM PILEATUM*, LINTON.

Our specimens of this tapeworm were collected from *Carcharinus gangeticus*, Müll. and Henle, collected in the Pusser river, Khulna, on October 21st, 1917.

We had 7 specimens.

Length 17 cms.

Number of proglottides in a specimen, counted—100.

Length of neck—5·2 mm.

Last proglottid—

Length—5·2 mm.

Breadth—2·1 mm.

The specimens differed from Linton's in the following particulars :—

1. Size.
2. Absence of orange coloured bands.

3. Size and shape of the proglottides.
4. Colour being pure white.
5. Genital pores being irregularly alternate.
6. Uterine cavities being absent.

V. TWO NEW SPECIES OF PARASITIC COPEPODS.

Ergasilus bengalensis, sp. nov.

(Plate XIII.)

Female (Fig. 1).—Head and first thoracic segment completely fused, with no indication of the line of union. The resulting cephalothorax is more or less elliptical, a little arched dorsally, and about twice as long as broad. No rostrum. First three free thoracic segments less than half the width of the carapace. The third, fourth and fifth thoracic segments regularly diminishing in length and breadth ; all three however are distinct. Genital segment barrel-shaped, with the sides evenly rounded, slightly longer than broad and about one and a half times the breadth of the fifth thoracic segment. Abdomen three-jointed and a little more than half the length of the genital segment. First segment longer than the second, which is slightly smaller than the third. The first segment is also longer than the third. Anal laminae rhomboidal, much longer than the last abdominal joint, each tipped with two setae, the inner seta nearly twice the length of the outer one. Egg sacs cigar-shaped, smaller than the animal in length, and one-fourth the breadth of the carapace with the six longitudinal rows of eggs. About 120 eggs in each sac.

First atennae (fig. 2) six-jointed ; joints of unequal length and width, last three segments setose, terminal joint with four setae. Second antennae (fig. 3) four-jointed, first joint roughly triangular, with the base attached to the ventral surface of the carapace. The second joint is attached to the anterior upper surface of the first joint, a little below the apex ; it is more than twice as long as the first, and the third joint is attached to its chisel-shaped distal extremity. The third joint is slightly smaller than the second, and considerably narrower. The terminal fourth joint has the form of a curved claw.

Mouth parts (Fig. 4).—Labrum (*La*) large, not reaching the base of the first maxillae. Mandibles (*md.*) with the cutting edge curved upwards and forwards, and with a group of spines at their inner edge ; mandibular palps large, triangular, densely covered with setae. Basal portion of the first maxillae (*mx. i.*) is an oval papilla with two large spines, of which the inner one is longer than the outer. The second maxillae (*mx. ii.*) have a broad base with a much smaller distal end, this end bearing a tuft of bristles on its anterior margin only. Labrum (*Lb.*) flap-like, with the ends running to the curved portion of the second maxillae.

First four pairs of swimming legs (figs. 5-8) biramose, all the rami three-jointed, except the exopod of the fourth pair, which has two joints. Fifth pair much reduced, knob-like, with a single spine. Basal joint of all quite broad.

The arrangement of the spines on the first four pairs is as follows :—

First exopod	1—0	0—2	1—4
„ endopod	0—0	0—2	1—5
Second exopod	1—0	0—2	II—5
„ endopod	0—2	0—2	1—3
Third exopod	1—0	0—2	II—5
„ endopod	0—2	0—4	1—4
Fourth exopod	0—0	III—4	
„ endopod	0—2	0—2	1—3

Colour of specimens preserved in spirit milky-white, with minute black pigment spots scattered on the dorsal surface of the carapace.

	mm.
Length	1·22
Length of carapace	0·71
Breadth of carapace	0·39
Length of egg-strings	1·09
Breadth of egg-strings	0·14

From the gills of *Wallago attu* (Bl. Schn.), Mirpur, district Dacca, Bengal, 3rd June, 1917.

Many specimens. Types in the collection of the Zoological Survey of India, numbered $\frac{9774}{10}$.

No males were obtained.

Ergasilus hamiltoni, sp. nov.

(Plate XIV.)

Female (Fig. 1).—Cephalothorax a little more than half the entire length and one and a half times as long as broad. First thoracic segment distinctly separated from the head by a groove. Head transversely elliptical, with evenly rounded anterior margin. First thoracic segment three times longer and a little wider than the head, quadrilateral in outline, with acutely rounded corners. Second, third, fourth and fifth thoracic segments diminishing regularly in length but about the same width. Sixth, or the genital segment, thrice as wide as the fifth thoracic ; barrel-shaped, with rounded sides.

Abdomen three-jointed, the segments diminishing regularly in length and width, the terminal one deeply notched in the middle. Anal laminae more or less squarish, smaller in width than the last abdominal segment, and tipped with two setae, the inner of which is three times the length of the outer. Egg sacs two-thirds the length of the entire body, ellipsoidal ; eggs large, arranged in five longitudinal rows, 60-65 in each sac.

First antennae (fig. 2) six-jointed, joints diminishing regularly in length and breadth ; all segments setose. The second antennae (fig. 3) are attached to the ventral surface just posterior to the bases of the first pair. They are four-jointed, first or basal joint large and swollen, the second joint one and a half time as long as the first, third joint

curved and half the length of the second, the fourth or terminal joint has the usual claw-like appearance.

Mouth parts (Fig. 4).—Labrum (*La*) extensively fused with the head, distinguishable only as a curved line reaching the bases of the mandibular palps. Mandibles (*Md*) with a short and broad basal joint, neck long and narrow, the cutting blade much longer than broad, and armed along the inner margin only. The mandibular palps elongated, with seta on the upper surface only. Basal portion of the first maxillae (*mx. i*) reduced to a circular papilla only, with two stout setae arising from the centre. The second maxillae (*mx. ii*) have a broad basal portion, while the distal portion (which is curved along its outer margin) appears as a second segment, articulating with the basal portion; this distal portion bears setae on its upper free surface. Labium (*Lb*) small, flap-like, and triangular in outline.

First four pairs of swimming legs (figs. 5—8) biramose, all the rami three-jointed, except the exopod of the fourth pair, which has two joints. The fifth pair reduced to an elongated process only. The arrangement of spines on the first four pairs is as follows :—

First exopod	0—0	0—1	11—5
„ endopod	0—1	0—1	11—4
Second exopod	0—0	0—2	11—3
„ endopod	0—1	0—1	11—4
Third exopod	0—1	0—1	11—4
„ endopod	0—1	0—1	11—4
Fourth exopod	0—0	11—4	
„ endopod	0—1	0—2	11—4

Colour of specimens preserved in spirit creamy yellow, with a large number of black pigment spots scattered on the dorsal surface of the animal. Eyes blackish, trilobate, in the middle of the head.

	mm.
Length	0·8
Length of egg-strings	0·52
Breadth of egg-strings	0·17

From the gills of the *Anabas scandens* (Daldorf). Gosaba, Sunderbans, Bengal, 11th December 1917.

Three specimens. Types in the collection of the Zoological Survey of India, numbered $\frac{9848}{10}$. This species is named in honour of Sir Daniel Hamilton of Gosaba, in recognition of the help given by him in the work of the Fisheries Department.

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EXPLANATION OF PLATE X.

FIG. 1.—Photograph of side view of *Anabas scandens* with Carcinoma.

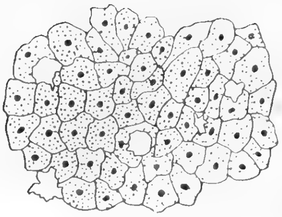
,, 2.—Photograph of the second specimen.

,, 3.—Photograph of the third specimen.

,, 4.—Enlarged view of the warty Carcinoma, ×4.

,, 5.—T. section of the Carcinoma, outgrowth.

4



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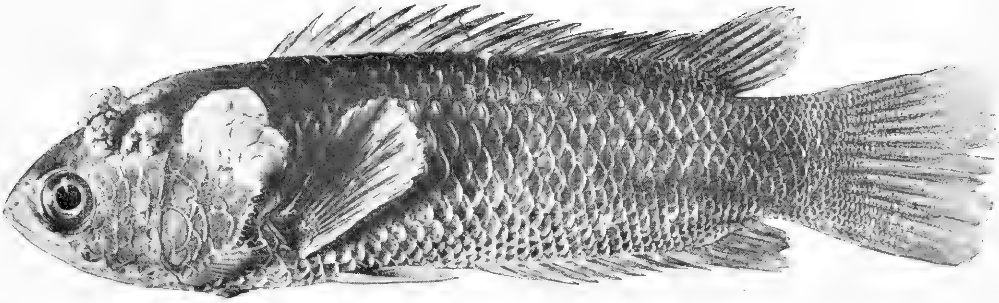

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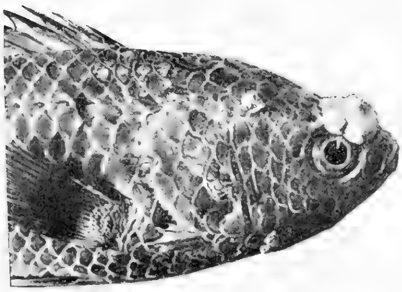

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CARCINOMA OF CLIMBING PERCH.

S. C. Mondul, phot.

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EXPLANATION OF PLATE XI.

FIG. 1.—Gill of *Labeo rohita* with cysts of *Myxobolus rohitae* on the filaments.

,, 2-4.—Propagative cells of *M. rohitae.*

,, 5-9.—Division of propagative cells.

,, 10 and 11.—Union of a micro- and macro-gametes.

,, 12-20.—Division of the micro- and macro-gametes, and the formation of the pan-sporoblast.

,, 21-22.—Division of the pan-sporoblast into two sporoblast.

,, 23-25.—Young spores in development.

,, 26.—Mature spore showing the structure.

,, 27.—Spore with the polar filament extruded.

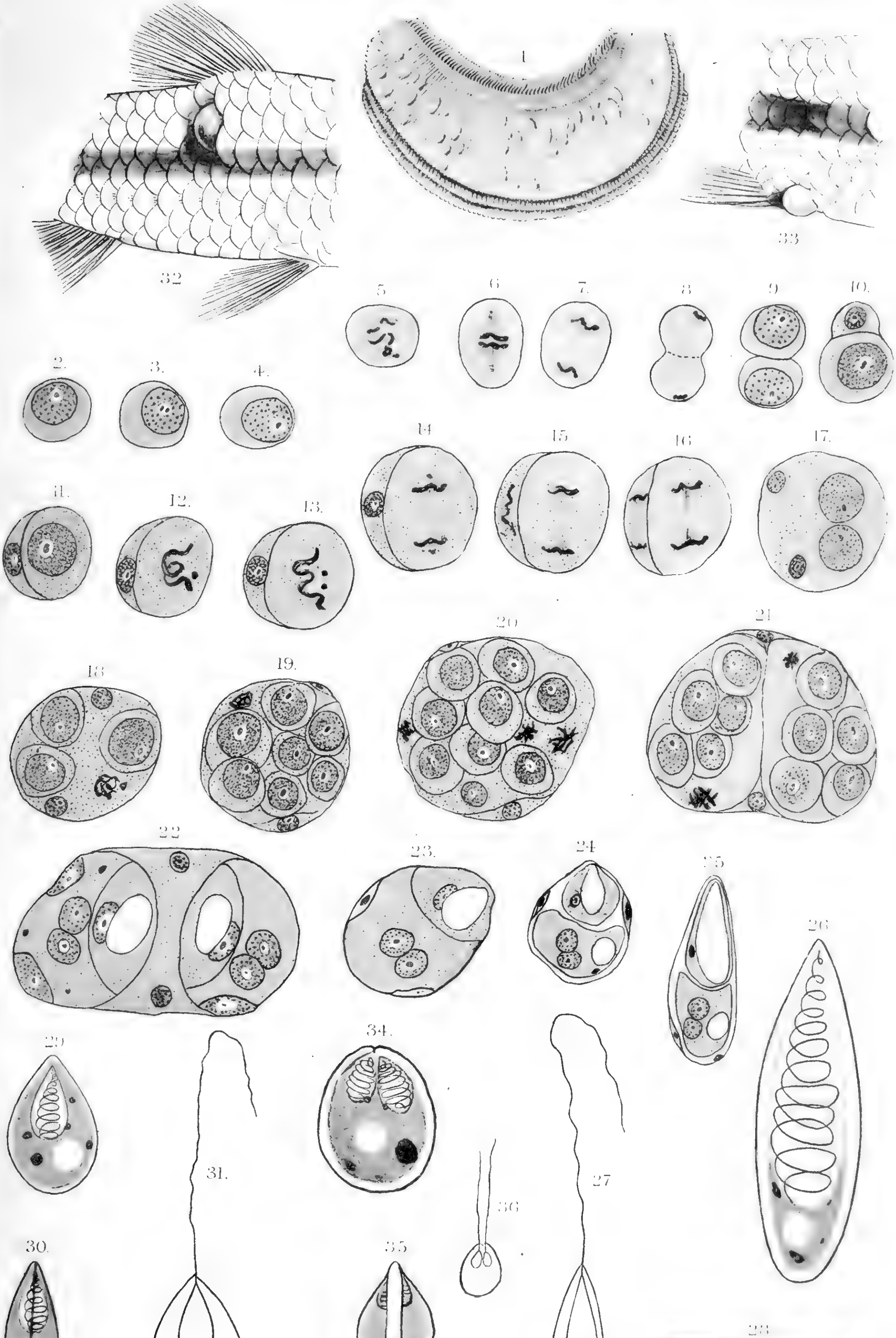
,, 28.—A portion of the caudal fin of *Labeo rohita* with a cyst of *Myxobolus seni.*

,, 29-31.—Mature spores of *M. seni.*

,, 32-33.—Side views of two specimens of *Rasbora daniconius* showing cysts of *Myxobolus nodularis.*

,, 34-36.—Mature spores of *M. nodularis.*

PLATE XI.



B. Prashad & A.C. Chowdhary, del.

INDIAN MYXOSPORIDIA.

EXPLANATION OF PLATE XII.

FIG. 1.—*Clinostomum piscidium.* Entire worm showing the anatomy.

,, 2.—Cercaria from the lateral muscles of *Saccobranchus fossilis.*

,, 3.—A cyst containing a Cercaria from the wall of the intestine of *Ophiocephalus marulius.*

,, 3(*a*).—Another specimen of the same while still enclosed in the wall of the intestine.

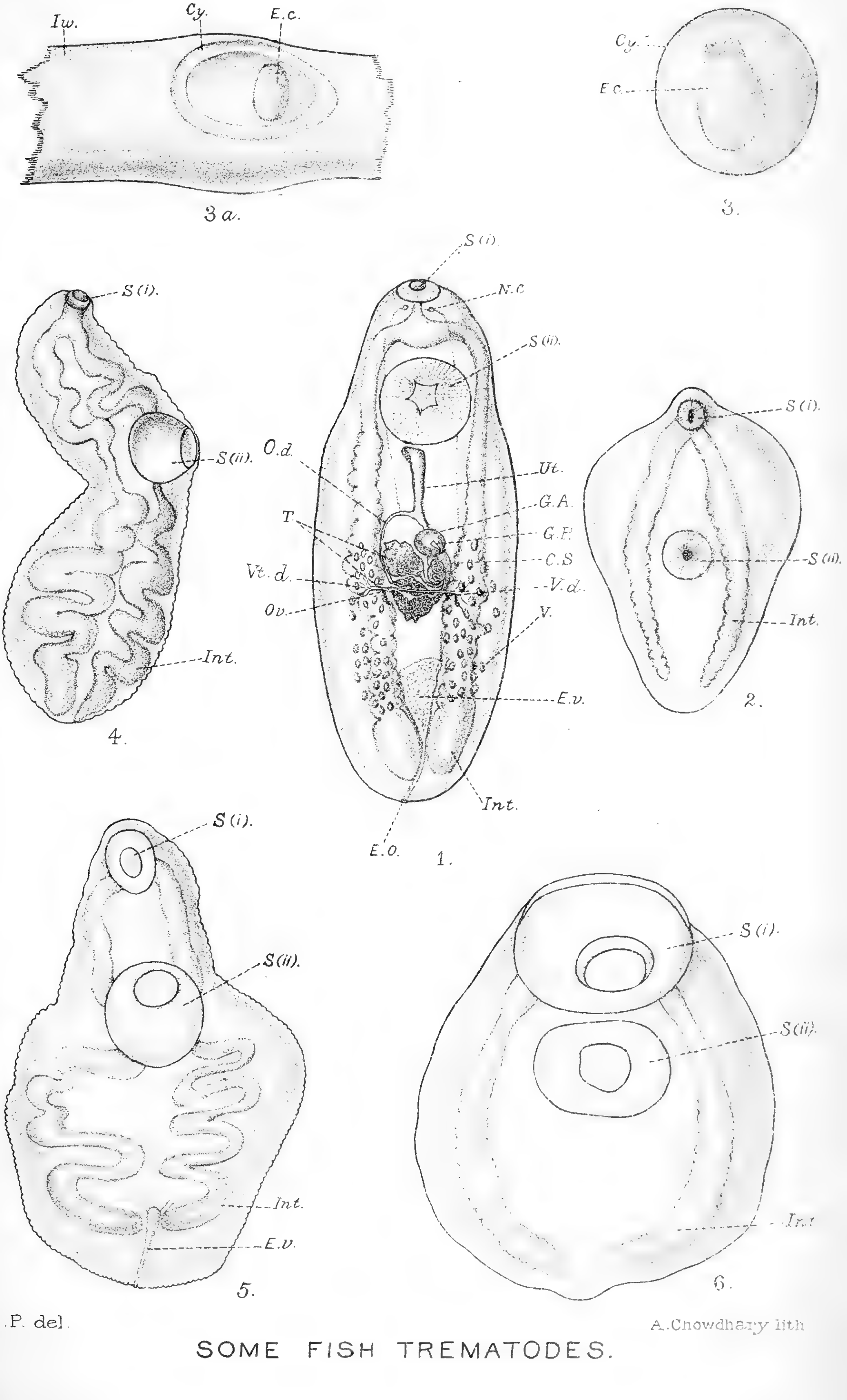
,, 4.—Cercaria from the lateral muscles of *Ophiocephalus striatus.*

,, 5.—Cercaria from the lateral muscles of *Ophiocephalus striatus.*

,, 6.—Cercaria from the lateral muscles of *Trichogaster fasciatus.*

EXPLANATION OF LETTERING.

C. S. Cirrus Sac. Cy. Cyst. E. C. Encysted cercaria. E. O. Excretory opening. E. V. Excretory vesicle. G. A. Genital atrium. I. W. Intestinal wall. Int. Intestine. N. C. Nerve collar. G. P. Genital pore. Ov. Ovary. O. d. Oviduct. S(i) Anterior sucker. S(ii) Posterior sucker or Acetabulum. T. Testis. Ut. Uterus. V. Vitelline gland. V. d. vas deferens.



B.P. del.

A. Chowdhary lith

SOME FISH TREMATODES.

EXPLANATION OF PLATE XIII.

All the figures are of *Ergasilus bengalensis.*

FIG. 1.—Dorsal view of the entire female animal.

,, 2.—First antenna.

,, 3.—Second antenna.

,, 4.—Mouth parts, ×1250.

,, 5.—First swimming leg.

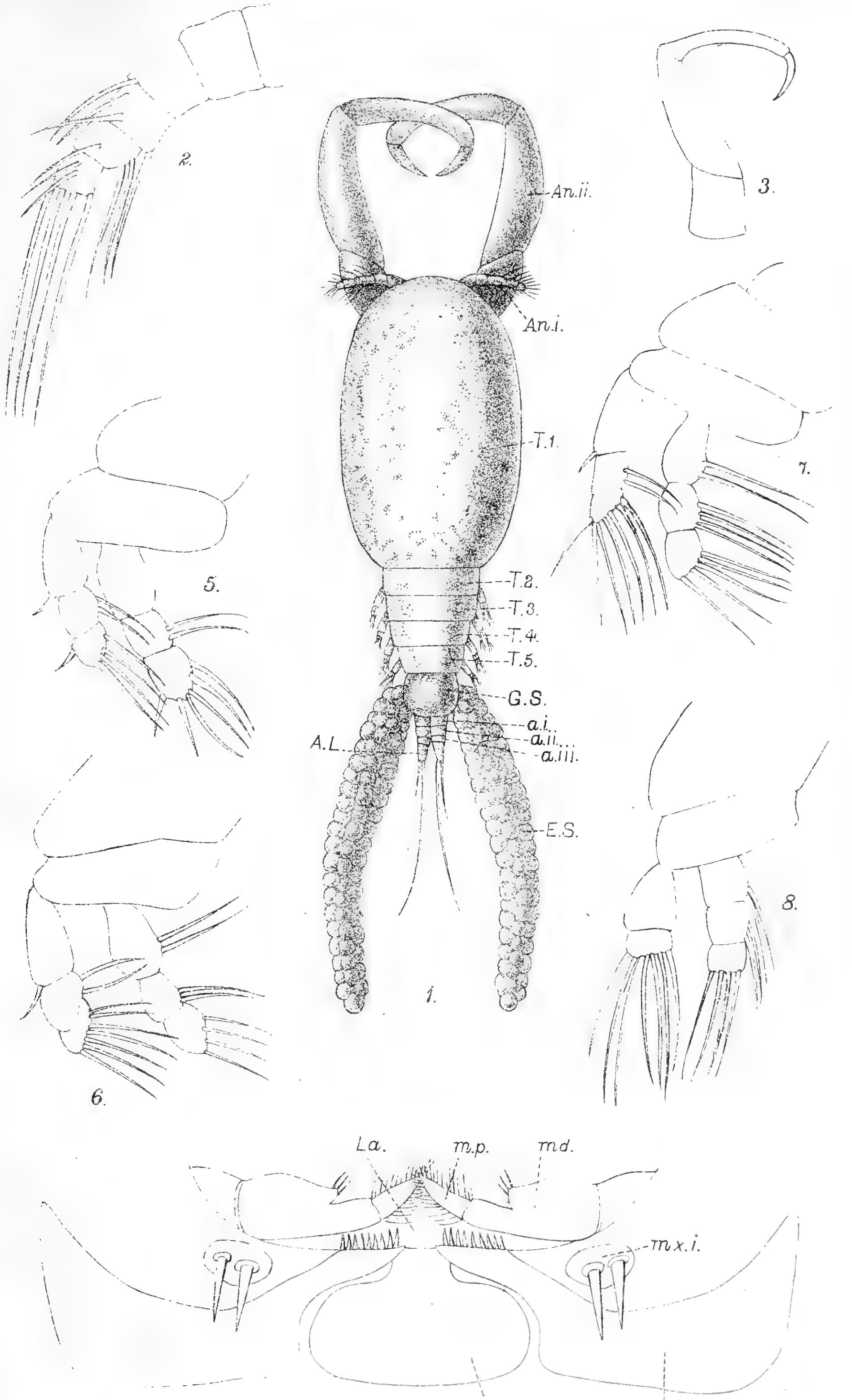
,, 6.—Second swimming leg.

,, 7.—Third swimming leg.

,, 8.—Fourth swimming leg.

EXPLANATION OF LETTERING.

a. i.—a. iii. First to third abdominal. segments. A. l. anal lamina. an. i. an. ii. First and second antennae. E. S. Egg sacs. G. s. Genital segment. La. Labrum. Lb. Labium. Md. Mandible. M. p. Mandibular palp. Mx. i., mx. ii. First and second maxillae. T. 2—T. 5. Second to fifth free thoracic segments.



B.P. del. D. Bagchi lith.

ERGASILUS BENGALENSIS.

EXPLANATION OF PLATE XIV.

All the figures are of *Ergasilus hamiltoni* ; reference lettering same as in plate XIII.

FIG. 1.—Dorsal view of the entire female animal.

,, 2.—First antenna.

,, 3.—Second antenna.

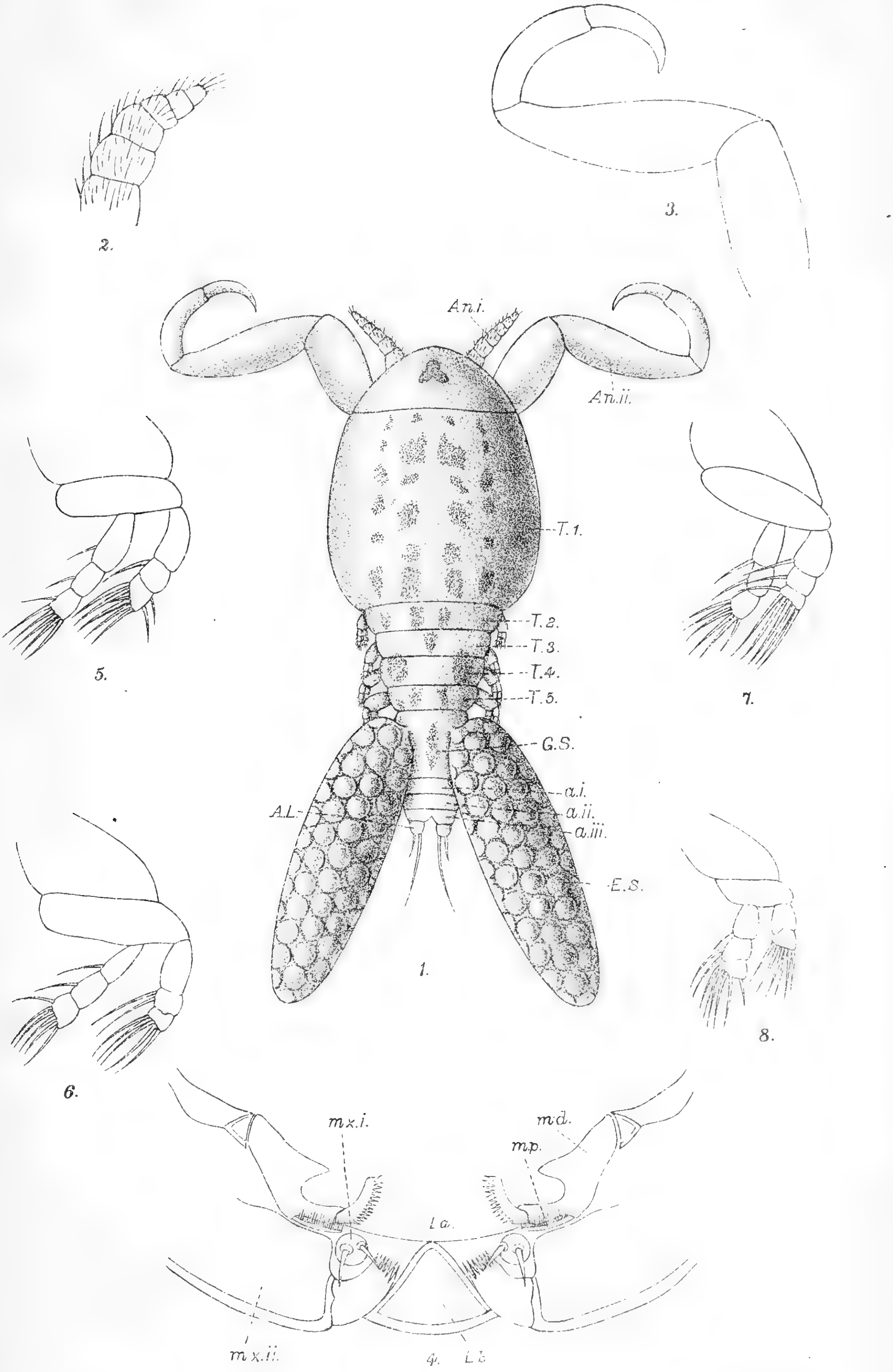
,, 4.—Mouth parts, $\times 1250$.

,, 5.—First swimming leg.

,, 6.—Second swimming leg.

,, 7.—Third swimming leg.

,, 8.—Fourth swimming leg.



B. P. del. S. C. Mondul lith.

ERGASILUS HAMILTONI.